ANSES Opinion
Request No 2012-SA-0036

The Director General

Maisons-Alfort, 5 December 2016

OPINION
of the French Agency for Food, Environmental and Occupational Health & Safety

regarding an assessment of the health risks of the use of devices for aesthetic procedures implementing physical agents

ANSES undertakes independent and pluralistic scientific expert assessments.
ANSES primarily ensures environmental, occupational and food safety as well as assessing the potential health risks they may entail.
It also contributes to the protection of the health and welfare of animals, the protection of plant health and the evaluation of the nutritional characteristics of food.

It provides the competent authorities with all necessary information concerning these risks as well as the requisite expertise and scientific and technical support for drafting legislative and statutory provisions and implementing risk management strategies (Article L.1313-1 of the French Public Health Code).

Its opinions are published on its website.
This opinion is a translation of the original French version. In the event of any discrepancy or ambiguity the French language text dated 5 December 2016 shall prevail.

On 13 February 2012, the Directorate General for Health (DGS), Directorate General for Labour (DGT), Directorate General for Risk Prevention (DGPR) and Directorate General for Competition, Consumer Affairs and Fraud Control (DGCCRF) submitted a request to ANSES to conduct an expert appraisal on the assessment of the health risks related to the use of devices intended for the performance of aesthetic procedures.

1. BACKGROUND AND PURPOSE OF THE REQUEST

Demand for aesthetic procedures is growing sharply, driven by the development of new devices using physical agents, involved in a wide variety of aesthetic applications.
According to the DGS, *"...many devices are used directly on people without having been rigorously studied in terms of their mechanism of action and the risks related to their use, both for the exposed population and for professionals performing aesthetic procedures..."*[1].

The various operators of professional devices (physicians in various fields and non-physician professionals, regardless of their status) have varying levels of training or no prior *ad hoc* training, which raises questions. In addition, some specific devices are readily available to private individuals, which raises the issue of the risks related to their use by private users, who by definition are untrained.
In this context, and given the "*serious complications*" related to aesthetic procedures that have been reported to the health authorities[2], the French Act on Regional Health Governance of 21 July

[1] See ANSES Request of 13 February 2012 (DGS, DGT, DGPR, DGCCRF).

2009, known as the HPST Act, introduced Articles L.1151-2 and L.1151-3 of the Public Health Code (CSP) allowing the Ministry of Health to regulate aesthetic procedures posing serious risks to human health and to prohibit procedures posing serious hazards or suspected of posing serious hazards.

Decree No 2011-382 of 11 April 2011 prohibiting aesthetic adipocyte lysis procedures drew the regulatory conclusions from an Opinion of 17 December 2010 issued by the French National Authority for Health (HAS), and banned certain aesthetic adipocyte lysis (destruction of fat cells) techniques posing a serious hazard as well as techniques using external agents (focused ultrasound, lasers, infrared, radiofrequency) suspected of posing a serious hazard to human health.

Following a request from several individuals, companies and trade unions involved in the performance of aesthetic procedures, by Decision of 22 February 2012, the Council of State annulled Article 2 of the Decree of 11 April 2011, considering that the content of the HAS's assessment did not provide justification for its conclusions.

With their formal request of 13 February 2012, the DGS, DGT, DGPR and DGCCRF wanted to obtain the following from ANSES in particular:

- an identification of the characteristics of the main types of radiation (wavelength, intensity, etc.), ultrasound and other external physical agents (cold, etc.) used to perform certain aesthetic procedures such as non-invasive hair removal and "lipolysis"[3];
- an assessment of their short-, medium- and long-term health effects related to their use by professional users on the one hand and by private users on the other;
- a comparative review of any current standards and regulations on these devices and an assessment of the safety guarantees they provide for professional and private users.

The studied aesthetic procedures are designed for lipolysis or hair removal, using devices implementing physical agents. They primarily use a controlled thermal effect. Any other effects that may occur, unintentionally, are considered in this expert appraisal as adverse effects related to the performance of aesthetic procedures.

The procedures examined in this expert appraisal aim to provide comfort and are not therapeutic in nature (treatment of pathological hirsutism, for example).

2. ORGANISATION OF THE EXPERT APPRAISAL

The expert appraisal was carried out in accordance with French Standard NF X 50-110 "Quality in Expert Appraisals – General Requirements of Competence for Expert Appraisals (May 2003)".

ANSES entrusted the examination of this formal request to the Working Group on Aesthetic Procedures, reporting to the Expert Committee (CES) on "Physical agents, new technologies and development areas". This Working Group, established following a public call for applications, brought together experts selected for their competence and independence in complementary scientific and technical fields, especially in medicine and physics. It held 35 plenary meetings (at ANSES) and 12 telephone meetings between April 2013 and May 2016. The methodological and scientific aspects of this group's work were regularly submitted to the CES, between 10 July 2012 and 7 October 2016. The report produced by the Working Group takes account of the observations and additional information provided by the Committee members. This work was conducted by a group of experts with complementary skills. It was carried out in accordance with the French Standard NF X 50-110 "Quality in Expertise Activities".

[2] *Ibid*.

[3] In the strict sense of the word, lipolysis refers to adipocyte lysis. In practice, the available data on the so-called lipolysis methods studied in the request do not indicate whether adipocytes are actually lysed. That is why the word "lipolysis" has been used in quotation marks to describe these methods.

ANSES analyses interests declared by experts before they are appointed and throughout their work in order to prevent risks of conflicts of interest in relation to the points addressed in expert appraisals. The experts' declarations of interests are made public via the ANSES website (www.anses.fr).

The Expert Committee (CES) on "Physical agents, new technologies and development areas" adopted this expert appraisal work along with its conclusions and recommendations, at its meeting of 7 October 2016.

Description of the risk assessment methodology

The Working Group relied on the following sources of information to conduct its expert appraisal:

- **available knowledge in the fields of dermatology and physics**, necessary to understand the interactions between the physical agents used by the devices and human physiology, in order to identify potential adverse effects. The Working Group sought to understand and explain the principles of operation of the non-invasive "lipolysis" and hair removal devices examined in the framework of the request;
- **a systematic study of the scientific literature** dealing with non-invasive "lipolysis" and hair removal devices, targeting clinical studies in particular. Of the 431 available articles that underwent two thorough readings by the Working Group's experts, 58 were selected based on the following criteria: comparative clinical study including at least ten subjects.
  This systematic research resulted in the identification of seven different physical agents used by non-invasive hair removal devices (ruby lasers, Nd:YAG lasers, alexandrite lasers, diode laser pulsed light, radiofrequency and electrolysis) and seven others for non-invasive "lipolysis" devices (Nd:YAG lasers, diode laser , pulsed light, radiofrequency, ultrasound, application of cold temperature, and mechanical massage combined with application of cold temperature). The various application/physical agent combinations were compared, in particular with regards to the mechanisms of the procedure, the study design, and reported adverse effects. These adverse effects were classified as mild or severe, depending on their level of impact on aesthetics or health:
    - mild adverse effects: low impact on aesthetics or health;
    - severe adverse effects: high impact on aesthetics or health.

  This classification was discussed by the Working Group, which defined it as precisely as possible given the descriptions provided by the authors of the analysed studies. The effects reported in the publications were classified as mild or severe based on the reading of the information provided, taking into account, among other things, the duration of the adverse effect, its intensity, and the affected surface area, when these data were available.

  For example, the Working Group classified the following adverse effects as mild:
    - local inflammation lasting less than 24 hours: limited erythema around the hair follicles, erythematous patches, peripapillary oedema, oedema on a certain area;
    - mild hyper- or hypopigmentation or transient hyper- or hypopigmented scars;
    - mild first-degree burn with a limited surface area;
    - superficial blister;
    - moderate pain of limited duration;

  and the following adverse effects as severe:
    - local inflammation lasting more than 24 hours;
    - extensive first-degree, second-degree or deep burn, whether extensive or not;
    - deep or extensive blister;

- intense and prolonged pain;
- eye damage;
- permanent pronounced pigmentation disorder or pigmentation disorder on a visible area such as the face;
- permanent scar;
- ulceration;
- uncontrolled dermal atrophy (lipolysis).

The exhaustive literature study of all publications identified up to June 2015 was supplemented, for updating purposes, by research covering the period from July 2015 to June 2016, which was limited to articles providing new information.
Moreover, the small number of publications selected in the systematic literature study, given their methodological weaknesses, led the Working Group to list the adverse effects reported in non-selected clinical studies, case series, case reports and systematic and non-systematic reviews;

- **hearings with representatives of professionals in the sector performing aesthetic procedures, qualified individuals, manufacturers and users** of non-invasive hair removal and "lipolysis" devices. These hearings were held between August 2014 and June 2015 and enabled technical data and information about field practices to be collected;
- **a study of the French regulatory and normative context**, in particular with regards to current practices.

3. ANALYSIS AND CONCLUSIONS OF THE CES

The analysis and conclusions of the CES on "Physical agents, new technologies and development areas" rely on the report entitled "Assessment of the health risks related to the use of devices implementing physical agents intended for the performance of aesthetic procedures" of the Working Group on Aesthetic Devices. The collective expert appraisal work was adopted by the CES at its meeting on 7 October 2016.

3.1. Results and conclusions of the collective expert appraisal

"Permanent" hair removal and "lipolysis" procedures are currently performed using devices intended for professionals, in medical practices, beauty salons or both. However, the practice of hair removal using home devices, primarily with intense pulsed light (IPL), is growing strongly. All these methods, given the physical agents used, can cause adverse effects. Accidents with varying severity levels and frequencies have been reported.

3.1.1. Mechanisms of action and potential effects of the physical agents used

The mechanisms of action of most devices result in a thermal effect applied to target areas. This effect is achieved more or less directly by the action of external physical agents: it destroys the targets by increasing or lowering the temperature. For "lipolysis", the claimed mechanism of action is adipocyte apoptosis. Furthermore, the physical agents used by aesthetic devices can induce other intrinsic effects on living organisms, whether intentionally or not.

Hazards related to thermal effects
At temperatures between 20°C and 43°C, the effects on tissues are reversible; the intended effects of aesthetic procedures are achieved below these temperatures, over periods of 30 to 60 minutes, or above them, over periods of a few dozen milliseconds.

Localised low temperatures, between -5°C and -12°C, induce adipocyte apoptosis opposite the cold source.

For high temperatures, the pain threshold temperature for the skin has been measured at 43.9°C. From 45°C, vasodilation and endothelial damage can lead to cell death. Tissue denaturation occurs above 50°C: enzymatic activity disappears. Cell membranes and certain proteins become disrupted from 60°C. Collagen, whose structure is more hierarchical, becomes dehydrated and is converted into fibronectin at around 75°C, causing the tissue structure to shrink. Coagulative tissue necrosis occurs between 60°C and 80°C. High-water-containing tissues are vaporised from 100°C, while a locally higher temperature is needed to vaporise low-water-containing tissues (example of bulbar melanin).

Note that very few data are available on temperatures induced locally in tissues through the implementation of the studied devices.

Other hazards:

- *related to radiofrequency*

The few quantitative data found on the frequencies and fluences used by marketed devices applying radiofrequency electromagnetic fields describe devices delivering high fluences (from 5 to 20 J/cm^2 at 1 MHz), although they are not precisely known. Therefore, the power levels of the devices used are likely to have adverse thermal effects.

Non-thermal effects related to radiofrequency have been thoroughly discussed in previous reports published by ANSES (AFSSET, 2009 and ANSES, 2013).

It is difficult to know if the current regulations on exposure to radiofrequency in the general population apply to these devices. However, Decree No 2016-1074 of 3 August 2016 on the protection of workers against risks related to electromagnetic fields applies to these devices used by professional operators.

- *related to optical radiation*

For devices delivering optical radiation, the most effective wavelengths for lasers and IPL devices are red and near-infrared wavelengths, between 660 nm and 920 nm, and then above 1040 nm, which determines the nature of usable lasers (ruby 694 nm, alexandrite 755 nm, diode 810-830 nm, Nd:YAG 1064 nm) and the range of wavelengths used for IPL devices (400-2200 nm). In this last case, if light is poorly or not filtered, wavelengths in the ultraviolet spectrum may be included (100-400 nm), causing photochemical effects (AFSSET, 2005 and IARC, 2009).

- *related to ultrasound*

At the power levels used by aesthetic devices, ultrasound devices do not have mechanical effects (cavitation for power above 3 W/cm^2). However, depending on tissue susceptibility, the period of use, and the maximum intensity of pulsed ultrasound, thermal effects are possible.

3.1.2. Adverse effects observed during the use of devices

The systematic study of the scientific literature led to the identification of observed adverse effects related to the use of hair removal and "lipolysis" devices for non-invasive procedures.

Hair removal devices

For hair removal, the principles of operation of devices implementing optical radiation are well known; however, the mode of action proposed for devices using radiofrequency is poorly documented. The analysis of the literature highlighted the fact that devices using lasers and IPL

have shown some efficacy, even though hair removal is not as permanent as suggested by some commercial brochures. A summary of the effects reported in the articles selected by the Working Group in the framework of its systematic study of the scientific literature related to non-invasive hair removal devices is given in Table 1. Regarding efficacy, the Working Group did not take a position and simply reported the efficacy indicated by the authors in the publications.

Table 1: summary of effects observed after treatment with non-invasive hair removal devices

Physical agent	**Number of studies taken into account**	**Results** (according to the authors)	**Adverse effects** (Y: yes; N: no)	
Ruby laser (694 nm)	**6 of 34**	**Efficacy:** ↘ in hair of 10% to 75%	**Immediate** - Mild: Y (all studies) - Severe: N **After several months** - Mild: Y (1 of 6 studies) - Severe: N	**Objective clinical findings:** - herpes - superficial burn - inflammation - skin erosion - purpura - transient hyper- or hypopigmentation **Functional symptoms:** moderate pain (lower intensity than with IPL)
Alexandrite laser (755 nm)	**10 of 64**	**Efficacy:** ↘ in hair of 35% to 85%	**Immediate** - Mild: Y (all studies) - Severe: N **After several months** - Mild: Y (1 of 10 studies) - Severe: N	**Objective clinical findings:** - blisters - vesicles - local inflammation: perifollicular oedema, erythema - most often hyperpigmentation, some transient pigmentation changes with no scars or persistent pigmentation disorders **Functional symptoms:** pain (lower intensity than with diode lasers), burning sensations during treatment
Diode laser (800 to 810 nm)	**15 of 73**	**Efficacy:** ↘ in hair of 35% to 90%	**Immediate** - Mild: Y (all studies) - Severe: Y (1 of 15 studies) **After several months** - Mild: Y (4 of 15 studies) - Severe: N	**Objective clinical findings:** - increase in sweating **Functional symptoms:** moderate pain (considered as more painful than IPL), burning sensations during treatment
Nd:YAG laser (1064 nm)	**14 of 69**	**Efficacy:** ↘ in hair of 23% to 67%	**Immediate** - Mild: Y (all studies) - Severe: N **After several months** - Mild: Y (7 of 14 studies) Severe: N	**Objective clinical findings:** - mild burns - blisters - perifollicular inflammation, erythema - transient pigmentation disorders **Functional symptoms:** moderate pain, burning sensations during treatment

Physical agent	Number of studies taken into account	Results (according to the authors)	Adverse effects (Y: yes; N: no)	
IPL (475 to over 1200 nm)	**10 of 46**	**Efficacy:** ↘ in hair of 33% to 84%	**Immediate** - Mild: Y (all studies) - Severe: N **After several months** - Mild: Y (1 of 10 studies) - Severe: N	**Objective clinical findings:** - blisters - local inflammation - hyper- and hypopigmentation, 3 reported cases of persistent hyperpigmentation after 9 months **Functional symptoms:** pain, burning sensations during treatment
Radio-frequency	**2 of 5**	**Efficacy:** ↘ in hair of 39% to 60%	**Immediate** - Mild: Y (all studies) - Severe: N **After several months**: N	**Objective clinical findings:** - blisters - local inflammation - transient post-inflammatory hyperpigmentation - increase in sweating **Functional symptoms:** pain
Electrolysis	**4 of 6**	**Efficacy:** ↘ in hair of 35% to 66 %	**Immediate** - Mild: Y (all studies) - Severe: N **After several months**: N	**Objective clinical findings:** - inflammation - transient hyper- or hypopigmentation - acne - scabs **Functional symptoms:** pain

The most commonly reported adverse effects in the articles selected for the systematic literature study are mild and are primarily immediate, localised, low-intensity and short-lived inflammatory reactions. Pigmentation disorders, which occur later, are observed less often. Moderate sensations of burning and pain during treatment, classified as mild adverse effects, have also been reported. One study also reported pain classified as a severe immediate adverse effect.

In the studies not selected for the systematic literature study, clinical cases and case series reported similar incidents and accidents, mainly on highly pigmented skin, such as mild burns and pigmentation disorders (that healed quickly without sequelae). Deep skin burns and eye burns were the most severe reported complications. In some cases they had permanent consequences. However, they are seldom reported and reflect the poor practices of certain operators.

Paradoxical hypertrichosis (excessive hair growth on a treated area) has also been described, but it is difficult to classify due to the lack of precise published data.

The analysed literature did not include any reports involving the possible transformation of benign skin lesions into malignant lesions, although this was mentioned during the hearings.

The incidence of accidents in France could not be assessed due to the lack of an accident register and the lack of a specific reply from the professional insurance companies that were contacted. Moreover, the observatories set up by learned societies receive very few reports.

Discharges into the environment in the form of fumes from treatments are not covered by specific regulations. Furthermore, these discharges have not given rise to specific studies on occupational exposure or their potential harmfulness. In addition, no studies have been published dealing with possible long-term effects on practitioners and the environments of medical practices.

"Lipolysis" devices

Regarding techniques implemented under the term "lipolysis", some types of devices are used with no certainty as to their mechanism of action or whether or not there is actual "lipolysis". Some devices using cold therapy have shown real efficacy; for others, the literature did not indicate whether they achieve real adipocyte lysis or if they induce significant adverse effects.

A summary of the effects reported in the articles selected by the Working Group in the framework of its systematic study of the scientific literature related to "lipolysis" devices is given in Table 2.

Table 2: summary of effects observed after treatment with non-invasive "lipolysis" devices

Physical agent	**Number of studies taken into account**	**Results** (according to the authors)	**Adverse effects** (Y: yes; N: no; NA: not applicable; MD: missing data)	
Diode laser (800 to 810 nm)	**2 of 10**	**Efficacy:** very limited (thigh circumference and appearance measurement)	**Immediate** - Mild: Y (all studies) - Severe: N **After several months** - Mild: N - Severe: N	**Objective clinical findings:** - local inflammation - increase in sweating **Functional symptoms:** pain
Nd:YAG laser (1064 nm)	**2 of 12**	**Efficacy:** ↘ in dermal thickness for 1 of 2 studies	**Immediate** - Mild: Y (all studies) - Severe: N **After several months** - Mild: N - Severe: N	**Objective clinical findings:** - local inflammation **Functional symptoms:** pain
Radio-frequency	**6 of 18**	**Efficacy**: significant to good (thigh and abdomen circumference measurement)	**Immediate** - Mild: Y (5 of 6 studies) - Severe: N **After several months** - Mild: N (5 of 6 studies, NA for 1 study) Severe: N (5 of 6 studies, NA for 1 study)	**Objective clinical findings:** - local inflammation **Functional symptoms:** pain
Cold	**8 of 22**	**Efficacy:** ↘ in adipose tissue thickness of 20% to 68%, but high variability	**Immediate** - Mild: Y (7 of 8 studies, MD for 1 study) - Severe: N (7 of 7 studies, MD for 1 study) **After several months** - Mild: N (7 of 8 studies, MD for 1 study) Severe: N (7 of 8 studies, MD for 1 study)	**Objective clinical findings:** - local and brief inflammation - increase in sweating during treatment **Functional symptoms:** pain, sensation of numbness (132 days in 1 case, transient for the others)

Physical agent	Number of studies taken into account	Results (according to the authors)	Adverse effects (Y: yes; N: no; NA: not applicable; MD: missing data)	
Mechanical massage	**4 of 11**	**Efficacy:** ↘ in thigh circumference	**Immediate** - Mild: Y (all studies) - Severe: N **After several months** - Mild: N - Severe: N	**Objective clinical findings:** - local inflammation - transient hyper- or hypopigmentation - acne - scabs **Functional symptoms:** "tolerable" pain, sensation of discomfort
Ultrasound	**No articles selected**			
IPL	**No articles selected**			

The most commonly reported adverse effects are severe inflammation and pain. Cases of transient hyper- or hypopigmentation, acne or scabs have also been reported, although less often, further to the use of diode lasers, cold lipolysis or mechanical massages.

Cold lipolysis has immediate side effects, including erythema and inflammation with oedema and pain; these effects spontaneously subside within a few hours. No increase in concentrations of measured circulating lipids was found in the literature. Pain with treatment can be non-negligible, often with a neurogenic component. No major side effects have been reported with this type of device when used as recommended by the manufacturers. However, there have been cases of paradoxical adipose hypertrophy of the treated area.

Weakness of the "tolerance" and "excluded long-term effects" components of the available studies for both hair removal and "lipolysis"

The available efficacy/tolerance studies are primarily devoted to examining the efficacy of devices. Their "tolerance" sections are short and also provide limited justifications for the lists of effects found. On this basis, it is difficult to know whether some effects are not observed because they do not occur or because they are not considered. Lastly, it is surprising that only short- and medium-term effects are studied. The potential long-term or chronic effects of the procedures performed with these devices are not taken into account.

3.1.3. Life-cycle testing and management for aesthetic devices

Marketed equipment is in principle distributed in accordance with the general standards established by the International Electrotechnical Commission (IEC) and transposed by the European Committee for Electrotechnical Standardization (CENELEC). However, there is no specific normative testing system for aesthetic devices placed on the market in Europe. Therefore, the "CE" and "CE Medical" markings, related to general standards, provide no guarantees as to the lack of adverse effects related to their use.

Currently, clinical studies undertaken prior to the marketing of devices are not systematically published or used for the granting of a pre-marketing approval.

Device maintenance and its traceability are not regulated by laws. Devices for professional use are usually verified by the manufacturer or distributor once or twice a year and are fitted with systems for automatic calibration at start-up or further to a change in treatment parameters. For devices for home use, preventive maintenance is also not required.

There is no monitoring or traceability for the destruction or resale of used devices, with or without repackaging in France or abroad. However, in accordance with Decree No 2014-928 of 19 August 2014 on waste electrical and electronic equipment and used electrical and electronic equipment, distributors of home devices are required to take back used devices.

3.1.4. Regulations and standards

Aesthetic procedures

French Act No 2009-879 on Regional Health Governance (HPST) stipulates that *"aesthetic procedures whose implementation poses a serious hazard or suspected serious hazard to human health can be prohibited"* with *"justification"*.

Regarding hair removal, the Order of 6 January 1962[4] excludes its performance by non-physicians in all forms, with the exception of tweezing and waxing. The argument relating to the adoption date of this Order of 1962, largely pre-dating the use of lasers and flash lamps for hair removal, used by some to defend their use, is clearly dismissed based on case law. A senatorial report (Bernard Cazeau, 10 July 2012) nonetheless highlights a paradox. Whereas the Order of 1962 bans the use of pulsed-light devices by beauticians for hair removal, they are able to use these devices to perform "photorejuvenation" treatments. In addition, the current French regulations do not prohibit the marketing, or use, of home IPL hair removal systems for private individuals with no particular training.

Regarding "lipolysis", there are no legal regulatory measures in France limiting the implementation of *"lipolysis techniques using external physical agents"*, whether by physicians or non-physicians.

In parallel with the regulations, manufacturers and professionals performing aesthetic procedures have also invested in the development of standards aiming in particular to "promote the sector", instil confidence in consumers and introduce rigour in the application of safety procedures. For example, various voluntary standards have been developed, in particular the experimental standard AFNOR XP X50-831-1, which applies to non-physicians, and the European standard NF EN 16844, which applies to physicians in France.

Devices used to perform aesthetic procedures

Aesthetic devices intended for both professional, including medical, and home use fall under the regulations applying to electrical and electronic devices, with requirements related to electrical safety (Decree No 2015-1083), electromagnetic compatibility (Decree No 2015-1084) and environmental protection (Decree Nos 2013-988 and 2014-928).

None of the home devices and only some of the professional aesthetic devices currently fall under the regulations on medical devices[5]. The general regulations applying to them provide very few guarantees as to their safety of use, even though they implement some of the same principles of operation as medical devices. A new European regulation under discussion could advance the issue in the future by identifying all or some aesthetic devices as medical devices, as is already the case for hair removal systems in the United States.

[4] Order of 6 January 1962 establishing the list of medical procedures that can be performed only by physicians or can also be performed by non-physician medical assistants or directors of medical testing laboratories.

[5] Medical devices comply with the requirements of Council Directive 93/42/EEC of 14 June 1993 concerning medical devices.

- Devices for professionals

Decree No 2012-1303 establishes the list of authorised uses for visible-beam lasers[6] in a class greater than 2, as defined by the NF EN 60825-1 standard. Thus, lasers used for hair removal or "lipolysis" are reserved for professional use. There are no equivalent requirements for IPL devices.

- Devices for private individuals

For home devices, the lack of specific user training accentuates the potential consequences of the few technical guarantees to which these devices are subject in the current regulations regarding their safety.

In parallel with the regulations, these devices are subject to various technical, general, and specialist standards intended in particular to ensure the safety of users:

- the EN 60335 standard on the electrical safety of appliances, whose implementation has become mandatory under the regulations;
- the NF EN 62471 standard on photobiological safety which, according to the analysis of the hearings undertaken by the Working Group, can be misinterpreted. In this case, the photobiological risk can be underestimated, causing the operator, who is poorly informed, to not use the recommended safety systems;
- the NF EN 60825-1 standard on the safety of laser products, whose latest version (October 2014), includes a new class, 1C, allowing laser radiation to be applied to the skin without any power or energy limitation. The output power of these laser devices could thus exceed the maximum level authorised in Class 2, according to Decree No 2012-1303 of 26 November 2012, which poses a problem of regulatory consistency, and potentially a health risk.

3.1.5. Regulation of the performance of aesthetic procedures

The hearings with professionals revealed that the regulations on the performance of hair removal procedures (aforementioned Order of 1962) are often not complied with. It is difficult to assess incident and accident rates due to the lack of organised vigilance in this area.

Many beauticians perform IPL hair removal, which the Order of 1962 prohibits them from doing. Medical articles report problems in the practices of non-physicians that can result in accidents. And yet training for beauticians includes modules on the use of hair removal devices, taught in part by device manufacturers. The interviewed representatives of the beautician profession requested that the Order of 1962 be amended to authorise them to perform IPL hair removal. The current situation frequently leads to disputes between physicians and beauticians regarding the illegal practice of medicine.

Physicians, including general practitioners, dermatologists and plastic surgeons, can perform hair removal procedures with all the devices available on the market, such as IPL devices, lasers and all other types of devices. There are training programmes that can teach them to use these devices, but no prior *ad hoc* training is required to perform these procedures. Training specific to each device is generally offered by the manufacturer or distributor, and sometimes by an informal "mentor".

A number of physicians arrange for one or more non-physician employees to perform hair removal procedures in their absence, which is not compliant with the legislation. However, the French

[6] Visible-beam laser: any device that can produce or amplify laser radiation whose beam is accessible.

Medical Board considers that: *"if the procedure is to be delegated to a trained assistant, the physician's presence in the practice is always required"*[7].

Nonetheless, the training of non-physician employees for the performance of aesthetic procedures varies considerably and the performance of these procedures under the responsibility of a physician is not subject to any recognised (by a third party for example) prior *ad hoc* training requirement. While the interviewed physicians do not want to reverse the Order of 1962, they would however like to be able to entrust hair removal procedures to employees once they have conducted a prior medical examination of subjects, allowing them to set the parameters of the devices and verify that there are no medical contraindications.

Regarding "lipolysis", it is important to distinguish between adipose tissue procedures that have shown no proof of real adipocyte destruction and cold lipolysis (or lipocryolysis). According to the hearings, cold lipolysis is performed by physicians only. There is currently no certifying initial or continuing training for these techniques and no exhaustive vigilance regarding these procedures.

3.1.6. Specific issues related to home hair removal devices

Many hair removal devices are readily available to private individuals. The analysis of documents related to marketed devices (user manuals) revealed several aspects likely to promote the occurrence of adverse effects. However, these documents do not always contain information that would enable their potential effects to be estimated, regarding the following points in particular:

- optimum fluency level to be used;
- indication of the recommended maximum frequency for the repetition of sessions;
- adaptation of the parameters of use to hair and skin colour;
- importance of not combining sessions with heavy sun exposure, dermal applications or the absorption of photosensitising products;
- recommendation to not apply the devices to skin lesions, to tattooed areas or in the event of certain diseases;
- verification of the proper functioning of the device by an after-sales department and frequency of these tests.

Regarding risks, the following information was missing:

- the risk related to repeated use at maximum intensity;
- the critical risk of eye exposure, for the person concerned and for his/her family.

All this information is not currently required by the regulations in force and its presence therefore cannot be verified for devices marketed in France. The Consumer Safety Commission states, in a 2014 report, that *"some manuals highlight that the devices have been clinically tested under dermatological supervision in a cohort of subjects"* (CSC, 2014). Nonetheless, this claim is not a guarantee for the performance of clinical studies prior to marketing.

In addition, home devices are used with no particular training, even though some manufacturers claim safety systems for devices that are supposed to prevent risk during use (overexposure, accidental eye exposure, burn in contact with the applicator, etc.).

[7] See Letter from the French Medical Board of 27 April 2016 in response to ANSES's request.

3.1.7. Observatory, medical device vigilance

There is currently no system for the mandatory reporting of adverse effects (incidents, accidents, etc.) related to aesthetic devices, whereas medical devices are subject to organised vigilance. In general, for devices used for hair removal and for lipolysis, the vigilance systems currently in place, developed on the initiative of companies or trade unions, are inadequate to ensure the effective collection of adverse effects, incidents and accidents related to the use of these devices. This situation does not provide users with feedback about problems, even when they are recurring. It is therefore difficult to assess incident and accident rates.

3.1.8. Insurance coverage for professionals performing aesthetic procedures

Insurance coverage for professionals (physicians, non-physician employees, beauticians) who perform aesthetic procedures was mentioned in the hearings held by the Working Group. Questions still remain as to the conditions in which this liability applies for various aesthetic professionals.

3.2. Recommendations of the collective expert appraisal

It is essential that regulatory provisions aim to ensure a high level of safety for the various types of devices, uses and users, in the context of aesthetic procedures. In general, the CES thus recommends amending the regulations on aesthetic devices and their use, in order to ensure the consistency of regulatory and normative texts.

The following recommendations clarify this primary recommendation.

3.2.1. Regarding aesthetic devices

Regulations and standards related to devices used to perform aesthetic procedures

Applying the requirements currently associated with medical devices to all aesthetic devices could help guarantee adequate safety levels. The CES therefore recommends subjecting aesthetic devices, including those for home use, to the same requirements as for medical devices. This is in line with the current draft European regulation on medical devices. It would include devices using electromagnetic waves, non-focused ultrasound and application of cold temperature. Devices implementing mechanical tissue massages and direct hair-cutting agents (razors) would be excluded. This adaptation of the regulations could involve changing the definition of medical devices.

Regarding the applicable standards, a reminder to device testing laboratories would clarify the required correct interpretation of the standard on photobiological safety (NF EN 62471), in order to avoid errors in the determination of the risk group, especially for pulsed sources such as flash-lamp devices (IPL).

Furthermore, the CES recommends updating Decree No 2012-1303 of 26 November 2012, to take into account the new 1C class of the NF EN 60825-1 standard on laser safety that authorises the application of laser radiation on the skin at a higher level than in Class 2. It recommends setting the maximum level of accessible radiation from the laser aperture at a level equivalent to the Accessible Emission Limit (AEL) for Class 3R.

Life-cycle testing and management for aesthetic devices

Pre-marketing testing of aesthetic devices

Professional and home hair removal and "lipolysis" devices should be tested through a pre-marketing technical and clinical evaluation, at the same level as medical devices for comparable applications. For this to happen, the features of devices need to be precisely known and clinical studies need to be undertaken complying with the current safety standards, for both efficacy and tolerance. This testing of devices should take into account safety of use, especially relating to eye protection.

Life-cycle maintenance and management for aesthetic devices

The CES suggests identifying every device and creating a monitoring sheet for it to ensure traceability all throughout its life cycle. This monitoring should consist of systematic maintenance procedures together with systems that periodically block the device to require a technical inspection and repair if necessary, including for home devices. For IPL systems, special attention should be paid to the long-term stability of the emission spectrum, in particular regarding the effective filtering of ultraviolet radiation.

Particular issues related to home devices

For home devices such as IPL and laser devices, the CES recommends that the features of devices be suited to use requiring no specific skills, in terms of both emissions (level of surface energy delivered, wavelengths, types of emitters, etc.) and safety systems, in order to prevent potential adverse effects, including those related to use that does not comply with the manufacturer's recommendations.

The CES recommends establishing a list of devices that have been tested as compliant and whose technical features, provided by manufacturers and distributors, are compatible with home use.

The CES also suggests undertaking information campaigns on the risks related to the use of aesthetic devices intended for private individuals.

3.2.2. Regarding the use of these devices by professionals and the general population

Regulations and standards

The CES confirms there is an inconsistent regulatory situation: the Order of 1962 bans the use of pulsed-light devices by beauticians for hair removal, whereas they are able to use these devices to perform photorejuvenation treatments. All these devices are likely to have adverse effects. The CES therefore recommends adapting the current regulations to correct this inconsistency.

Furthermore, there are no regulations on the implementation of *"lipolysis techniques using external physical agents"*, whether by physicians or non-physicians. Given the potential adverse effects generated by the use of these various types of devices, a suitable regulatory framework should be established.

Recommendations for use

Implementation of devices for the performance of aesthetic procedures

- prior to use, verify that there are no skin lesions and that there is no equipment likely to be affected by the type of physical agent used;

- avoid applying the device twice to the same area during the same session.

Thermal effect

- avoid the risk of burns, by optimising the duration of application taking into account the energy delivered per unit area and the frequencies involved, and by using cooling agents for all untreated contiguous areas;
- control possible risks related to fumes and particles produced during certain treatments.

Radiofrequency/electrical current

- verify the path for the flow of induced current applied based on the location of the electrodes.

Optical radiation

- ensure eye protection for treated subjects as well as for operators, by providing safety glasses effectively filtering the wavelength(s) used and by using safety systems keeping the light beam from unintentionally spreading to the eyeball;
- for devices delivering optical radiation, use long wavelengths (such as the 1064 nm for Nd:YAG lasers) and low fluences for the darkest skin. These instructions are also valid for the use of home devices;
- systematically interview people before performing aesthetic procedures to detect any history of photosensitisation or photosensitising treatments in progress. In the event of exposure to a photosensitising product, avoid using aesthetic devices using optical radiation, even though pharmacovigilance has not reported any cases of photosensitisation to date.

Ultrasound

- comply with the maximum temperature limit tolerated by human tissues with no irreversible damage (in particular for subjects with a high body mass index, for whom tissues can have longer thermal relaxation times), depending on the frequency, power and time of application. This objective could be achieved either by using appropriate device designs or by integrating temperature-control systems.

Cold lipolysis

- limit the size of the treated area to which vacuum pressure is delivered;
- advise against this technique for all subjects with a history of hernia or surgical procedures on the area considered for treatment;
- conduct a medical examination during the post-treatment phase.

Qualification and roles of professional operators

Devices and their conditions of use change rapidly. In connection with a marketing authorisation, the qualifications required for use by professionals should be specified for each device. The CES thus recommends developing mandatory validating initial and continuing training programmes, in accordance with the current regulations in France, for all types of users of aesthetic devices.

Creation of an authorisation for the use of aesthetic devices

The CES considers that all professionals (physicians, physician assistants, beauticians) who use aesthetic devices should have an authorisation covering the ability to:

- justify the relevance of the procedure in relation to the objective;
- optimise techniques and the configuration of devices;
- perform procedures in accordance with best practices;
- inform customers and contribute to medical device vigilance for aesthetic devices.

The CES recommends supplementing this authorisation with continuing training for maintaining up-to-date technological knowledge.

Training during the acquisition of any new device

When an aesthetic device is installed for a professional, the distributor/manufacturer should offer specific mandatory training for the operator(s) (physician or otherwise). It should not be possible to accept or use any devices without receiving this training and recording it on a standardised written document, kept available for the authorities by the device's distributor and by the professional user.

Information about the treatment process, the physical agent used, the type of device, the terms of use and the potential risks should be clearly specified during this training, taught by professionals who can demonstrate they have suitable technical skills for training operators.

Procedures performed by employees in medical practices

The CES points out that procedures performed by employees are the physician's responsibility.

Employees working in medical practices with an authorisation to handle aesthetic devices could, under the responsibility of a physician, perform hair removal or "lipolysis" procedures under the following conditions:

- before any aesthetic procedure, the subject should have been examined by the competent physician, in order to ensure there are no contraindications and define the type, number of sessions and physical parameters of the treatment to be applied. The CES also recommends that the physician see the subject again at the end of each session, and obviously if there are any side effects;
- the responsible physician must be present on the premises during the entire period in which these procedures are performed.

Home devices

For home devices, user manuals should explain all of the precautions to be taken and the recommendations for use; users should have the ability to make a technical appointment with a competent person in the event of problems. The sale of home equipment to private individuals in France should comply with the French and European regulations. Moreover, devices whose type and/or power level is reserved for professionals should not be available for sale to private individuals. Compliance with this restriction should be monitored in practice, irrespective of the sales method (e-commerce, etc.).

Recommendations to guarantee conditions of safety, traceability and information for users

The CES advises the public authorities to study the feasibility of setting up a declaration system before any aesthetic professional can establish their practice, to guarantee conditions of safety, traceability and information for users.

Observatory, medical device vigilance, mandatory reporting

An exhaustive and centralised vigilance system should be set up to provide precise knowledge of incidence rates for adverse effects by type of device (laser, IPL, etc.). The CES recommends subjecting adverse effects, incidents and accidents occurring during the use of aesthetic devices to mandatory reporting.

To process collected information, the CES recommends implementing a medical device vigilance system for aesthetic devices after they are placed on the market, whether or not they are CE marked. The aims of this vigilance system would be to collect, evaluate and monitor reports of incidents, to prevent them from (re)occurring (defined in Article L.5212-2 of the Public Health Code). The case of home devices should be specifically taken into consideration.

3.2.3. Recommendations for studies and research

The literature study found the available studies to be quantitatively and qualitatively weak. Therefore, the CES recommends undertaking clinical and epidemiological studies compliant with the current quality standards, with sufficient statistical power to assess efficacy and tolerance:

- use validated and homogeneous assessment criteria from one study to the next;
- undertake tolerance studies over long periods;
- undertake specific studies on environmental consequences, for example on the effects of treated people and exposed professionals inhaling fumes and particles.

4. AGENCY CONCLUSIONS AND RECOMMENDATIONS

ANSES endorses all the conclusions and recommendations, reiterated in Section 3 of this opinion, of its Expert Committee on "Physical agents, new technologies and development areas". It supplements them below.

Given the increase in demand for aesthetic procedures and the range of devices and technologies currently available on the market, special attention should be paid to potential risks related to these practices.

The assessment of risks related to the use of aesthetic devices undertaken by ANSES highlighted the small number of available clinical and epidemiological studies of adequate quality, which made it complicated to carry out this expert appraisal dealing with two types of practices: hair removal and lipolysis. In the framework of its systematic study of the scientific literature, due to the poor quality of the available articles, the Working Group was required to set undemanding selection criteria (comparative clinical study including at least ten subjects) as compared to standard practices in the area of medical studies. Even so, less than 14% of the analysed articles were selected.

The expert appraisal nonetheless found that adverse effects were systematically observed in the analysed studies.

Regarding devices for the performance of hair removal procedures (lasers, IPL, radiofrequency, electrolysis):

- all the comparative clinical studies included in the systematic literature study reported "mild" adverse effects related to the use of these devices (for example: local inflammation lasting less than 24 hours; mild hyper- or hypopigmentation or transient hyper- or hypopigmented scars; mild first-degree burn with a limited surface area; transient moderate pain, etc.);
- only one selected comparative clinical study reported a "severe" adverse effect: intense pain felt throughout the duration of a hair removal treatment performed with a diode-laser device;
- other severe effects were reported in retrospective case reports not selected in the systematic study. Deep and extensive burns, as well as eye burns, were described. They were the result of the poor practices of certain operators.

Regarding devices for the performance of lipolysis procedures (lasers, application of cold temperature, radiofrequency, mechanical massage):

- most of the studies selected in the systematic literature study reported mild effects (local inflammation, transient hyper- or hypopigmentation, etc.);
- the most significant mild adverse effect was reported in a case series (not selected in the systematic study): it involved paradoxical adipose hypertrophy or paradoxical adipose hyperplasia, a local decrease in the fat layer, followed by hypertrophy of this area. This adverse effect was observed following cold lipolysis treatments. Its low incidence may explain why it was not reported in the clinical studies, due to their lack of power;
- no severe effects were identified in the selected or non-selected studies in the systematic literature study.

In the specific case of devices using radiofrequency, the few available quantitative data on emission powers and exposure levels raise questions, with regards to knowledge of the short- and long-term effects of this radiation and the applicable regulatory exposure limit values for other radio equipment.

Lastly, no conclusions could be drawn regarding the potential long-term effects of exposure to the physical agents used by aesthetic devices. Indeed, no publications specifically dealing with them were found during the expert appraisal.

Therefore, ANSES stresses the need to take measures intended to limit the occurrence of the adverse effects observed.

To do so, the Agency recommends revising the entire regulatory framework for aesthetic devices implementing physical agents, with the aim of better protecting the health and safety of private and professional users.

It thus highlights the relevance of the recommendations formulated by its Expert Committee on "Physical agents, new technologies and development areas", in particular regarding the application of the requirements currently associated with medical devices to all aesthetic devices. This recommendation should fit into the context of the current European work aiming in particular to revise the regulatory framework for medical devices.

ANSES also recommends studying the relevance of a measure on the non-use of such devices, in a professional context, on minors or before a set age.

In addition, ANSES recommends providing mandatory prior information on the risk of potential adverse effects to people undergoing aesthetic procedures:

- for example in the form of a free and informed consent for aesthetic procedures performed by professionals;
- and in all cases through a clearly legible label on devices intended for private individuals and professionals, and in their user manuals.

Lastly, no assessments have been published on the potential long-term effects on the health of professionals performing these procedures or on the environment. ANSES therefore draws attention to the issue of the safety of professionals performing aesthetic procedures, who can be exposed to physical agents as well as to fumes and other emissions.

Dr Roger GENET

KEYWORDS

Amincissement, appareils à visée esthétique, cryolipolyse, épilation, IPL, lasers épilatoires, lipolyse, lumière pulsée, radiofréquences, risques sanitaires, ultrasons.

Slimming, aesthetic devices, cryolipolysis, hair removal, IPL, hair removal laser, lipolysis, pulsed light, radiofrequency, health risks, ultrasound.