

Permanent hair removal

Dr. med. Johannes Lang
Präsident des ELAS e.V.
European Laser Aesthetic Surgery e.V.



Leiter von

DR. LANG



Laser im Zentrum von Erlangen
Hauptstraße 21
91054 Erlangen
Germany
+49 9131 829282
info@dr-lang-lze.de

The history

of lasting hair removal has seen a great variety of approaches. In the middle of last century, electro coagulation was considered to be the most effective method of lasting removal of unwanted hair, despite causing damage and scarring.

The concept of using light to reach this Holy Grail has brought various laser and flash lamps into play in recent decades.

The most effective and gentlest technique is selective photothermolysis of the hair follicle. Non-selective procedures cause more undesirable side effects than the intended result. Methods that primarily target the hair shaft naturally do not provide lasting results. Other target areas, for example follicular papilla cells, play a secondary role and only have a minor effect on very light hair.

Selective Photothermolysis

These images show the functional principle:

A target is selectively heated (thermo-) by photons (light) and thereby broken up ("-lysis"), i.e. destroyed, and then dissolved by the body ("lysed"). For lasting hair removal the target structure is the source of hair growth: the hair follicle.

To be completely precise, destruction of the hair follicle/papilla is done by indirect selective photothermolysis where the laser energy is primarily focused on the pigment edge around the active follicle/papilla.



Anatomy

On people's faces and bodies are very different types of hair. From the top of the head to the chin, for example, one can differentiate the main hair (capitium), the downy hair (vellus hair), brow, lash and ear hair (3 distinct types) as well as beard hair (terminal hair). Differences also arise with respect to the thickness, pigmentation, structure, and growth and development phases.

All these factors have a part to play in the procedure. The basic premise for effective, lasting hair removal is not just the correct laser, but also the "correct" hair. The hair follicle only has a direct connection with the pigment edge (the actual laser energy target) during the growth phase (image 2).

In the plateau and regression phases the primary target (pigment) separates from the ultimate target to be destroyed (origin of the hair = follicle) (image 3)

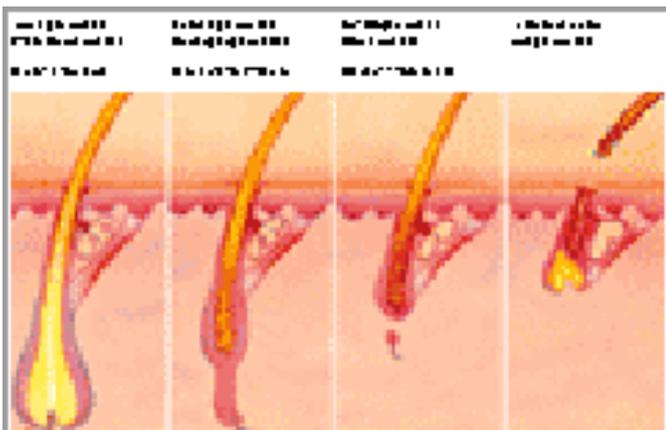


Best suited are:

Thick hair – the thicker the hair, the more the pigment surrounds the follicle

Dark hair – the darker the hair, the more eumelanin (part of the pigment) exists, providing a larger area for absorption of the laser energy. The dark eumelanin is better suited for absorption than the lighter pheomelanin. Grey or white hair has little or no remaining pigment.

In the growth phase (anagenphase) of the follicle-papilla there is direct contact between pigment and follicle. In light, untanned skin – the less pigment-rich the skin is, the smaller the amount of energy absorbed by the outer layer. Subsequently the effect on the lower layers



is greater and the side effect on the pigment is reduced. A UV-activated melanocyte is many times more likely to be affected than a passive pigment cell.

Wavelength

The effect of a laser is determined by various physical parameters. To get the best combination of greatest penetration depth below the skin surface, and good selectivity of target structure, a wavelength band from 750nm to 950nm should be used. Shorter wavelengths (in the visible spectrum) will damage the skin surface without having an adequate effect at deeper levels, due to their limited penetration.

Longer wavelengths (far infra-red) are absorbed to a greater degree by water and to a smaller degree by melanin and hence heat everything unselectively, having a reduced effect with worse side effects.

Other Parameters

There are further factors to consider in optimising as far as possible on the one hand the effectiveness on the hair, and on the other, care of the surrounding skin.

Impulse duration

Because the primary target structure and the ultimate goal, despite being in close proximity, are not one and the same, we must allow the heat impulse, and hence the laser impulse some time to penetrate the hair follicle. Generally, for thin hair 50 to 100 milliseconds are adequate, whereas for thicker hair (beard hair) 300 – 350 milliseconds are better

Spot diameter

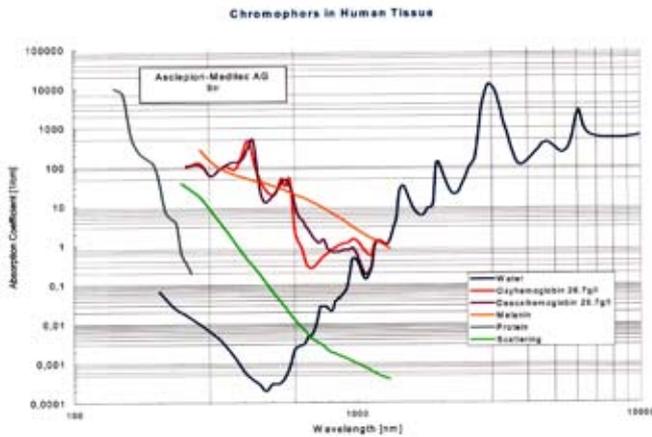
The following principle applies only to extremely deep laser: the smaller the spot (beam diameter) that hits the surface of the skin, the more energy gets trapped in the outer layers (by reflection, absorption, spreading out) hence the more cutting is the effect of the laser beam. Cutting is certainly a fairly drastic expression to use in this context, but it is symbolic of the tendency to endanger the skin surface as little as possible.

Using the energy levels set by laser epilation, a safe result is possible with a spot diameter of 6-7mm.

Energy density

By choice of the energy level that will be applied to the skin surface in order for adequate energy to reach the pigment edge surrounding the hair follicle deeper (several millimetres) in the skin, you can direct an energy density for effective destruction of a follicle and pig-

ment according to skin type, tanning type and above all, hair structure. Using a wavelength of 800 nm the energy density can be from 35 to 60 J/cm².



Skin cooling

One of the most important protection mechanisms to guard against side effects such as redness, swelling, pigment change or worse, is the simultaneous surface cooling of the skin.

By consistent cooling before, during and after the laser impulse, the skin surface, and with it, the pigment-bearing layer can be protected from potentially damaging temperature spikes from below. The time of pre-cooling should be about 1 second of contact cooling, or 3-5 seconds of airstream cooling.

For dark skin types (IV and V after Fitzpatrick) up to about 2 seconds of contact cooling at 0°C. Skin type VI after Fitzpatrick (if it is considered sensible to use laser epilation on this skin type) for 3 seconds at 0°C of contact cooling before, during and after. Contact cooling must be done using clear gel.

Taboo Zones

Basically some areas should not, or should only with extreme caution be treated with a deep penetrating light beam (deep laser or IPL!)

Eye sockets are absolute taboo zones. If, for example, when treating eyebrows it is possible that the laser beam may be reflected into a section of the front of the eye, then the procedure is not safe!

Therefore the upper edge of the eyebrow is generally good and safe to treat, whereas the lower edge is frequently not, or at least should be restricted to the lateral 1/3, and that only whilst raising the skin of the brow! Naturally, the same goes for the eyelashes.

From a functional perspective, hair in the aural canal should also not be treated. It would also be difficult to reach this area.

Applications Module

MedArt 435 MedArt 413 MedArt 525 MedArt 520

I would like to further explain this admittedly somewhat dry operational information using the MedArt Laser with the romantic name 435:

In detail

Laser MedArt 435

Wavelength 810 nm

Impulse duration 10 - over 1000 milliseconds (practically ca. 200 - 350 ms)

Spot diameter 8 mm

Scanner MedArt 413

Scan field with 1, 3 or 9 points

Energy density <1 to 160 J/cm² (practically appr. 35 - 75 J/cm²)

Contact surface 30 x 35 mm

Cooling MedArt 525

Simultaneous cooling, entire field to 0°C (Cooling Med-Art 520 to 3°C)

Scanner

The scanner removes some of the work for the operator. The operation gains precision and speed with the highest possible setting of laser points on a nominated scan area. According to the size of the area and pain perception of the patient you can choose between the full field with 3x3 points, the lineal scan with a row of 3 points or a single "shot" to individual hairs.

Non-linear scanning

To maximise the comfort of the patient the sequence of 9 laser impulses to the full field are interspersed with gaps. In addition, between the first "salvo" of 6 impulses and the last 3 impulses a small pause is incorporated. These fine variations in applying the power have proved themselves effective in practice. Together these "gap-linked scans" result in a 50 % improvement in comfort or an increase in effective energy density of between 10 and 20 %!

Comfort

There are different user and patient comfort features as follows:

The ergonomic shape of the light handset contributes to user comfort, as does the speed of procedure. The effective skin cooling and “gap-linked” scan configurations are decisive comfort features for the patients.

Settings

When used correctly, the safety margin (the difference between useful energy and potentially harmful energy levels) is very great. From my personal experience I would like to give the following overview of the settings that normally lead to success:

Table I

Skin type after Fitzpatrick	I – III	IV – V	VI
Watt	86	82	75
Joule	42	40	35
I° TIX after Lang	42	38	-
II° TIX after Lang	40	36	-
III° TIX after Lang	-	-	-

Particular care is needed for fresh UV exposure (TIX xf / f), sensitizing medication/drugs (TIX d) and for 3 weeks following sunburn before treatment is undertaken (TIX b). In these cases generally only a test setting as with TIX III° is indicated.

When adjusting these values the remaining parameters (impulse length in milliseconds) are adjusted automatically.

The scan-delay is set at a standard value of 1 second but can be adjusted to the following values for particularly sensitive patients, or particularly sensitive areas:

1. Extending the scan delay or reduction of the scan area (from 9 to 3 or from 3 to a single point).
2. As a rule, reduction of the energy level (joules) is not necessary.

Before the Treatment

Naturally, a clear explanation to the patient is as important as optimal treatment.

Basic Prerequisites

Even though the MedArt 435 Laser with simultaneous cooling is, without doubt, one of the safest systems for lasting hair removal, you should not introduce unnecessary risks. Therefore it is advisable not to treat freshly or heavily tanned skin.

As a broad rule skin types I - III after Fitzpatrick and TanIndex TIX I - II° after Lang (2003, in *Ästhetische Dermatologie* 1/2003) can be treated without dramatic reductions in normal energy level.

For darker skin types IV and V the value must be decreased (see Table I). To find out whether or not a laser epilation for a (tanned) skin type VI is sensible, a test on a representative area should be carried out.

Risks:

If heating of the melanocytes is too strong they can be damaged, at the very least temporarily.

The result is epidermal damage which primarily appear as superficial violet-brown, slightly rough patches within 24 to 48 hours / partly with bullose substructure. These “unsightly marks” that female patients describe are well known to IPL users. If the energy level has not been completely excessive, pale skin / partly pink flecks will remain between the brown. Light means no (or virtually no) melanin granules and active melanocytes, pink indicates incomplete regeneration after the treatment. Fortunately, lasting damage (corresponding scarring) is very rare with correct use. Normally the skin colour returns to normal after a few weeks.

Causes of error

Possible Causes of Error when using the MedArt - Systems 435 with simultaneous cooling, MedArt 525 / 520 and Scanner 413 (in order of likelihood):

- Treatment without gel between the cooling element and the skin
- Lack of contact between the cooling element / gel film and the skin surface during the procedure
- too low cooling temperature, or cooling turned off
- treatment of too recently or heavily tanned skin
- treatment of too dark a skin type with too high an energy level setting
- too high an energy density
- cosmetics / pigments on the skin

Pre-treatment

Although it is not scientifically proven that regular shaving stimulates hair growth, it is our experience that treatment with laser epilation following such treatment significantly improves results.

Treatment following plucking or epilatory cream use, or, in fact with no pre-treatment (body hair growing out) typically gives a worse result than treatment following regular shaving.

Shaving is, however, not unreservedly recommended in all cases (see below).

Laser treatment should, in principle, only be used on skin free from cosmetics. Pigments between the laser and skin surface can lead to thermal damage and epidermolysis just as can pigments within the surface of the skin (see above).

Acute folliculitis is an indication rather than a contraindication for this treatment. Where an area is already sensitive, a reduction in laser energy could be used.

Disclaimer:

MedArt A/S undertakes no liability whatsoever for any damage or injury arising as a result of the operator's lack of qualification to evaluate the treatment applied in the actual individual circumstances or as a result of errors or mistakes committed by such operator who would otherwise be considered as having the necessary professional skills to apply such treatment.

MedArt

MedArt A/S
Valseholmen 11-13
DK-2650 Hvidovre
Denmark
phone: +45 3634 2300
fax: +45 3634 2323
email: info@medart.dk
www.medart.dk

Permanent hairremoval - Tips and Traps

Dr. med. Johannes Lang
Präsident des ELAS e.V.
European Laser Aesthetic Surgery e.V.



Leiter von

DR. LANG

Laser im Zentrum von Erlangen
Hauptstraße 21
91054 Erlangen
Germany
+49 9131 829282
info@dr-lang-lze.de



Tips and Traps

Pressure

In the treatment of particularly pain-sensitive patients it is advisable to increase the pressure of the cooling handset on the skin surface.

It is particularly important to increase the pressure for treatment of overlying varicose veins. The pressure forces the blood out of the blood vessels. This means the haemoglobin is not targeted and hence side effects like pain and unnecessary irritation of the veins is avoided.

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Shaving / hair length

As normal for laser treatment, the hair should be as short as possible. This reduces pain and irritation in the skin.

If the hairs frequently become ingrown after shaving, it is recommended that shaving with a razor is done 3 days before the therapy, or that the hair is cut with shears in order to avoid ingrown hairs following the treatment.

More hair following the treatment????

No hair follicles are stimulated through laser treatment using the appropriate energy level.

However, some other factors can coincide:

Acute Phase: If a patient already has excessive hair (and with it, the tendency to grow more), a new hair growth phase can occur at the time of the treatment.

Pre-treatment: In the case of regular shaving before the treatment, this can stimulate the growth of new follicles and cause development of new hair (controversial views, see above). The same can apply to the light hairs between the stimulated dark hairs. In such a case of "mixed hair" it is not necessarily recommended to shave in preparation (see above).

Further tips and traps issues will appear periodically.

I welcome any questions:

E-Mail: dr.johannes.lang@t-online.de

MedArt

MedArt A/S

Valseholmen 11-13

DK-2650 Hvidovre

Denmark

phone: +45 3634 2300

fax: +45 3634 2323

email: info@medart.dk

www.medart.dk

Treatment scope

- * Hair removal on all Fitzpatrick skin types
- * Vascular and benign pigmented lesions
- * Interstitial treatments, e.g. intraluminal vein occlusion, haemangiomas

Unique product features

- * Super long pulses up to 1000 msec.
- * Treatment on all Fitzpatrick skin types
- * No consumables, no regular maintenance
- * Portable unit

Description

The MedArt® 435 is a 90 watt CW (continuous wave) diode laser, which makes it one of the most powerful and best laser systems in the market for permanent hair removal.

The laser works at the 810 nm wavelength which is the superior wavelength for targeting melanin, the target chromophore found in hair follicles. When laser light is applied to the epidermis, the energy is absorbed by the melanin in the hair follicles. The energy is transformed into heat, which destroys the hair follicle and surrounding structures. Permanent hair removal is thereby achieved.

However, as melanin is also found in the skin itself, a certain portion of the laser energy is absorbed outside the target structure, i.e. the follicle, with the risk of unwanted side-effects, especially in darker skin types. In order to preserve the skin from any unwanted side effects such as blisters and dyspigmentation, the MedArt® 435 utilizes two essential factors: pulse length and cooling.

The MedArt® 435 works with pulses up to 1000 msec. This means that the pulse width is sufficiently long to ensure a safe treatment for darker skin types but at the same time it allows for a sufficiently high dosis of laser energy to be delivered to the target area without compromising safety.

The MedArt® 525 cooling unit is an integral part of permanent hair removal. Cooling is carried out pre-, parallel- and post treatment by the use of a sapphire contact cooling window. The laser light is transmitted through the sapphire cooling window and the aggressive cooling, down to 0°C, allows for a high dosis of laser energy to be distributed to the target area, while the epidermal melanin is protected.

It is worth noting that this cooling method is considerably cheaper than e.g. cryogen spray cooling, as the cooling liquid is a simple solution of demineralized water and pure alcohol.

In order to ensure fast and even treatments, the MedArt® 413 scanner is an important part of the hair removal system. The scanner distributes a series of 8 mm spots over the treatment area. In fact, around 5.7 cm² are covered in just one scan, lasting only about 1 second. This means that a full back can be treated in less than 30 minutes, making this laser one of the fastest in the market.

The MedArt® 435 laser is also very well suited for benign vascular and pigmented lesions, which are easily be treated by the use of special easy-to-attach handpieces or in cases of interstitial treatments, with bare fiber.

More information is available upon request.



Male patient, 30 years old,
Fitzpatrick skin type II

Settings

Output power: 83-86 W
Spot size: 8 mm
Fluence: 32J/cm²
Pulse width: Approx. 188 msec.
Cooling: 3°C

Conclusion

The patient received two treatments with a scanner distributing 8 mm spots over the treatment area. The patient achieved almost 80% hair reduction. No side effects were observed.