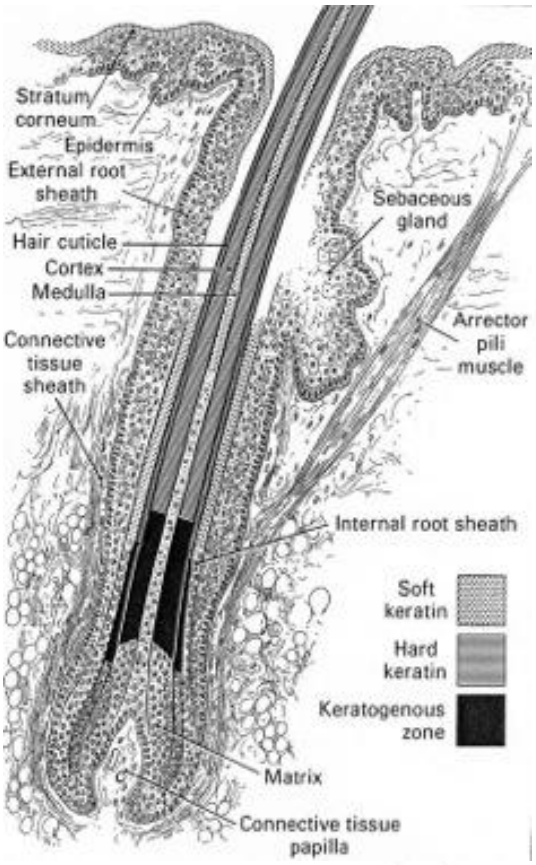
Feature Article

Guide to Using Laser Technology for Hair Removal

There are many different systems on the market for hair removal. It is possible to divide them in two different groups: absorption and transmission lasers. The absorption devices (ruby, alexandrite and 810nm diode lasers) have high absorption by melanin and lower by haemoglobin and water. The transmission lasers (neodymium-YAG and 915nm diodes) have high penetration in the tissue and coagulate directly the bulge and the surrounding vessels. Lastly, there are IPL devices which can help us with hair removal.



Our target is to destroy the stem cells that are on the hair shaft and dermal papilla. They are colourless which makes them difficult to be targeted by light devices, so we need to coagulate and thermally destroy the keratinocytes surrounding the stem cells at the bottom of the hair shaft and dermal papilla to be able to hit them. To achieve this you need to use a minimum temperature of 65 degrees Celsius at a depth of one to four millimetres in order to achieve good coagulation and thermal destruction of the stem cells. By doing this, the lower part of the hair shaft and dermal papilla are destroyed permanently. We say permanently but not definitively, because after all the hormonal changes in the body during puberty, 15–20% of hair follicles will not have created hair shafts in the body and more than 30% on the face and neck. Therefore it is impossible to destroy all the hair we have, we can only destroy the hair that has been not in a “sleeping” situation, as they cannot be destroyed until they receive vascularisation to create a new hair shaft.

It is important to know the different phases of hair growth – anagen, catagen and telogen. Interaction in the anagen phase is likely to give better results in fewer treatment sessions.

When carrying out hair removal treatments, we will be exposed to certain challenges, treating patients with a high phototype and tanned skin, treating sensitive areas, treating complex anatomical areas and getting unexpected poor results. When treating a patient with a high phototype or tanned skin, the absorption lasers – alexandrite, ruby and 810 nm diode lasers – have a high absorption by melanin on the hair shaft and epidermis. Those devices may be the gold standard to treat dark, thick hair on white skin but should not be used on phototype IV, V, VI and phototypes I, II, III with very thin, light hair because it's too risky. The light doesn't know where to deposit the energy and it is likely to cause burns or post-inflammatory hyperpigmentation.

It is vital to thoroughly evaluate patients to avoid complications. Never treat a patient who has had sun exposure in the last few days. You need to wait a minimum of four weeks before treating with an alexandrite ruby or 810 diode laser and a minimum of seven days when using a Neodymium-YAG laser or 915nm diode laser. Talk with the patient, take a good clinical history and ask about sun exposure – not just on the beach but daily exposure in the last two to four weeks.

Alternatively we can use devices that give us information about the quantity of melanin and quantity of redness on the body. Those devices are very low cost and give realistic information about melanin in the skin. You need to obtain measurements of melanin in a patient’s skin by evaluating the “real” phototype from the wrist of the hand, an area which does not get much sun exposure. Then measure the phototype in the area you want to treat and if the quantity of melanin is

multiplied by two or more, treatment is too risky. Even if you reduce the energy with an alexandrite laser to 12 joules per centimetre square, if a patient is recently tanned and doesn't tell you or you don't take measurements, you can burn the patient. Another way to prevent secondary effects is to cool the skin. By cooling the skin you reduce the risk of burning when applying high energy. You may apply high energy if you feel the hair shaft does not have enough colour compared to the epidermis to receive the energy selectively. So when you treat thin, light hair it is important to cool the skin because you will need to use higher energies.

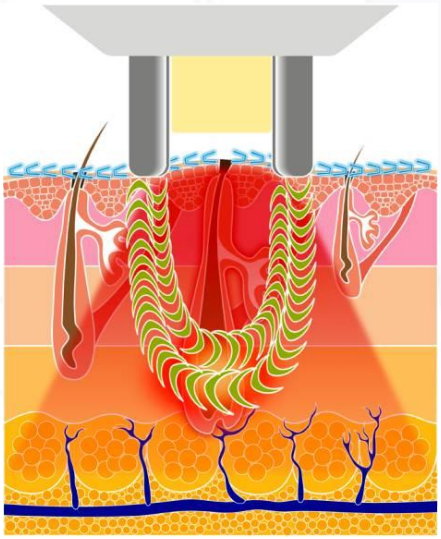
To treat a patient with a high phototype or recently tanned skin, you can select a wavelength with less absorption by melanin – a transmission laser, 915nm or 1064nm. If you only have a regular diode or alexandrite laser, you would have to increase the pulse duration of the laser, but doing this you sacrifice the effectiveness of the treatment. Pulse duration is not related to the phototype of the patient – pulse duration is related with the thickness of the hair. Thinner hair needs shorter pulse duration, larger hair needs larger pulse duration. If you enlarge your pulse duration on thin hair, you are sacrificing the effectiveness.

During recent years we have been considering other ways of treating patients with high phototypes or tanned skin. **Apogee Elite from Cynosure** is a device combining two wavelengths, Neodymium-YAG and Alexandrite on a blend mode. One after the other, milliseconds apart, you can shoot with Neodymium-YAG and then Alexandrite. This protocol reduces the energy needed for each one of the wavelengths and decreases the risk of superficial burns by a half. A study which took place in the IML Clinic in Madrid demonstrated that 54% of Neodymium-YAG plus 46% of Alexandrite, one just before the other, was the best combination, but the efficacy obtained was exactly the same as one shot of Alexandrite.

Another device that can be used on patients with high phototypes is the 810nm diode laser with high repetition rates and low energy, the first such device was the **Soprano from Alma Lasers**. This is not a regular diode laser, it has the regular mode with the high energy pulse and different pulse durations but also has the ability to work with dynamic epilation using low fluence and eight repetition rates, ten shots per second. Soprano hair removal efficacy cannot be explained by photothermal theory like other devices, but by the fact that the accumulation of heat on the dermis after each pass of the laser would destroy the stem cells on the hair shaft and dermal papilla. This dynamic epilation is less painful, although when you increase the number of passes on the same area you increase the heat and this increases pain sensation. The last pulses are going to be much more painful than the first ones, but it can be considered as a less risky and less painful technique.

The gradual increase in heat within the dermis explain the lower risk of superficial burns of this technique and the ability to treat higher phototypes and long lasting tanned skin. It's an interesting device but very technically dependent. You need to move the handpiece correctly: if you move too quickly, you don't increase the energy enough and if you move too slowly, you can burn the skin. A problem with this device is that you cannot set the pulse duration you want. You have pre-fixed pulse durations and pre-fixed energies. You have limitations as you cannot adjust the duration and energy separately, and you cannot use very short pulse durations which is needed for very thin hairs.

Another similar device on the market which uses this same theory of accumulated heat is the **eLase from Syneron-Candela**. It works in exactly the same way with pre-fixed pulse durations and pre-fixed energy. The difference is that the eLase needs less power as it uses ELOS technology, a combination of radio frequency (RF) and light. Radio frequency is not selective to any chromophore, it doesn't look to the melanin and is only influenced by resistance, the electrical impedance of the tissue. If the device delivers RF before the light of the 810nm diode laser, the dermis will be pre-heated and the fluence needed to achieve a coagulation threshold will be less. The temperature delivered by RF will specifically increase in the part surrounding the hair shaft and dermal papilla as this is the most resistant structure we have in the dermis. You will increase the vasodilation and the extravasation of the plasma. If you apply RF and light simultaneously, light will be selective and RF will be deposited in the area with highest resistance. You can decrease the energy of the light because we have the synergy of the electrical current and light both creating heat. The electrical current and light together increase the temperature to 55–65 degrees. This is why RF is used, as it is less risky than the light especially for patients with tanned skin and high phototypes.



Areas such as the ears, nose, and the upper lip are complicated to treat using a diode laser. It is very difficult to place the sapphire or quartz crystal of a diode laser in a perpendicular and covered position, so it is easier to use an Alexandrite, or Neodymium-YAG laser. It is important not to angle the handpiece to prevent bad results on hair removal caused by partial coagulation of the hair shaft and dermal papilla. Also take care with excess refrigeration.

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It can reduce the effectiveness of the Neodymium-YAG laser, which has absorption by haemoglobin because it decreases the diameter of the vessels feeding the dermal papilla if skin is cooled too much.

We can have problems on hair re-growth when trying to treat a delimitated area or just one hair. While you may see one hair, the patient can have many “sleeping” hairs in the area and if you treat with a laser, you create a scattering effect, heat not just in the area being treated, but in the surrounding areas. This heat has been proven to create neovascularisation, vasodilation and increase the blood flow to the bulge area of “sleeping” hair. This situation can cause re-growth of those follicles. Don’t treat outside of the pre-treated areas, don’t treat individual hairs and don’t treat with low energy in large spots because you increase the scattering effect. Make sure you always refrigerate the surrounding areas to prevent this unwanted effect.

Bad results on areas like the naso-labial area can also be explained by a bad stretch of the skin. Sometimes we have patients who don't get good results: patients who have undergone up to ten sessions in an area which is easy to treat, without any apparent problems, no hormonal problems. We have recently started a study at the King Juan Carlos University in Madrid (Spain) to try to clarify those situations and problems related to oestrogen receptors of the dermal papilla can be part of the explanation of those bad results.

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Dr. Pablo Naranjo has more than 10 years experience in the field of medical aesthetics and is the Medical Director of Elite Laser in Madrid, Spain. Following his medical degree, he undertook a Masters in Administration and Management of Health Services (with distinction), a Masters in Aesthetic Medicine (with distinction), where his dissertation looked at aesthetic treatments with Q-switched laser and then a Doctorate in Medicine (Summa Cum Laude). He is a member of the Aesthetic Medicine and Cosmetic Registry in the Medical Association of Madrid. He is also a Coordinator, Lecturer and Honorary Associate of the Master’s degree in Aesthetic Medicine of the Rey Juan Carlos University of Madrid, covering modules in Laser and IPL. Pablo has been the European Clinical Director for Candela Corporation, a leading manufacturer of devices for aesthetic laser treatments, since 2008.