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Laser Innovations in Aesthetics

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Abstract
Laser has caused a revolution in technology and today there is almost no field of natural sciences in which Laser is not already used. The evolution of technology, knowledge, and science offers plenty of laser devices used to treat aesthetic facial and body problems. Before a laser treatment that is aimed at addressing these aesthetic problems, the device operator must know the history of Laser devices so that it can understand the modern laser devices used today. This study presents all the innovations of laser hair removal, regeneration, and lipolysis.

KEYWORDS
laser innovations, multiple wavelengths in hair removal, diode laser 1060nm, lipolysis

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1. INTRODUCTION

The name Laser comes from the initials of the words Light Amplification by Stimulated Emission of Radiation. It is essentially an enhanced light, which has a unique color. Today, Laser devices are characterized as one of the most interesting technological achievements of recent years. Laser radiation emission devices are used worldwide designed and intended for technical purposes and others for therapeutic [1].

The first experiment that led to the construction of the first laser device was conducted in 1960 and was the Ruby Laser device. This was the first successful operation of a laser device. Since then, there has been a huge development of laser devices that aim at their therapeutic activity.[2] From 1965 to 1972, several dozens of scientific conferences were held, while hundreds of clinical trials on laser devices used in medicine for therapeutic purposes were published. In general, both the mechanisms and the effects of laser radiation were studied on people with various

diseases. In 50 years, at least 1000 books and monographs were published, and thousands of clinical studies on laser technology were performed. The results of scientific research on Laser devices have been applied to clinical practice in various areas (such as oncology, surgery, dermatology, and dentistry). Since the 19th century were known the therapeutic properties of light such as ultraviolet radiation, and red or blue light. These were isolated with special filters from the total spectrum of light radiation, and this discovery was the basis for a new field, the field of phototherapy. In 1903 N. R. Finsen was honored with the Nobel Prize in recognition of his contribution to the treatment of various diseases, especially Lupus vulgaris, using light radiation, thereby opening new paths to the medical community [3,4].

2. LASER CATEGORIES

Laser categories depend on their active material, hazard, emission power, etc. Two main categories depending on their emission power are the high power laser (thermal effects) such as Ruby Laser, ND: YAG, Alexandrite, CO^2, etc., and low power such as He-Ne, etc., in which their radius does not produce heat (non-thermal effects) [5].

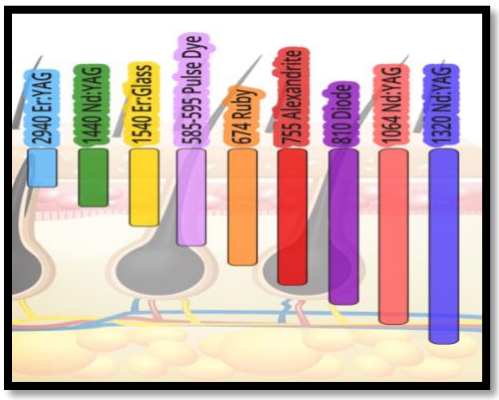
High-power Lasers are used in hair removal and regeneration of the skin. Ablative and non-ablative lasers are used to regenerate the skin. Ablative lasers increase the temperature at the cellular level, under the effect of the light beam of a high-intensity laser, resulting in inhibition or disappearing individual or even total vital functions. As the energy of the laser increases, the effects become inhibitory and then cytotoxically. As the energy continues to increase further, the tissues are heated and the results are heat, with a shrinkage followed by cell death and ultimately evaporation of the tissue. That is, it gradually becomes reflection, heat, dehydration, and even tissue decay (e.g. in medical applications) [6].

The low-intensity lasers achieve a stimulant effect on the cell or tissue, causing several reactions. Laser light at low energy levels (LLLT) is called biodegradable [7]. This results in the influence of metabolism in one direction. The thermal effect itself causes an increase in metabolic activity. The results after low-power laser application are photod stimulation and biodegradation [8].

3. LASER IN AESTHETICS

Laser in aesthetics is undoubtedly one of the greatest achievements of recent years, in hair removal, tattoo removal, skin regeneration, and reduced adipose tissue [6,9]. Laser has emerged as an effective tool that gives the best therapeutic effects from other light sources, defining the appearance and development of a quality new direction, this phototherapy/therapy with laser [10].

In aesthetics and dermatology, are used LLLT devices that have beneficial effects on fine face lines, wrinkles, acne scars, hypertrophic scars, and rapid healing of burns. LLLT can reduce damage from ultraviolet radiation both as a treatment and as a precautionary measure [11]. Each of the different wavelengths also has a different absorption from the ingredients of the tissues. The wavelength has a specific depth of penetration and each laser device affects differently on the tissue that receives its radius. The chromophores of the tissues that selectively absorb the energy of the Laser radiation, depending on the wavelength they emit are hemoglobin in the blood, the melanin on the skin, and the water in all tissues) [9,12].



[**Figure 1**]: Laser applications depend on the wavelength they emit. The wavelength at 2940nm improves scars, wrinkles, and melasma (water), at 1440nm and 540nm improves photoaging (water), at 585-595nm improves telangiectasia (hemoglobin) at 694nm removes unwanted hair (melanin), at 755nm and 810nm removes unwanted hair (melanin, hemoglobin), at 1064nm removes unwanted hair, improves wrinkles, scars, and fat reduction (hemoglobin melanin), and at 1320nm improves wrinkles, and scars (water). Finally, at 10600nm (water) with CO2 for tumors.) (modified by Dr. F. Biskanaki, 2021)

4. LASER HAIR REMOVAL INNOVATIONS

In the past, there were laser hair removals devices by chose a wavelength but as a result, limited the options of skin types on Fitzpatrick (I-VI). People who wanted to remove unwanted hair with a laser should had placed half an hour before Laser

treatment cream with lidocaine to reduce pain during application. Also, it was used cryotherapy (e.g. ice cubes) for reducing pain and burns. Furthermore, the speeds of the older machines were slow (e.g. 1Hz), resulting it was needing more time for the laser treatment. The screens of lasers were buttons, without easy customization and ready-made programs [4,9].

Nowadays, in addition to the three well-known wavelengths in hair removal (755nm, 800nm, 1060nm) for their effectiveness, some devices combine more than two wavelengths, simultaneously on a laser device. There are lasers with double wavelengths 755nm and 810nm, 755nm, and 1060nm, or 810 and 1064nm. Also, there are with multiple wavelengths at 755nm, 810nm, and 1060nm, or 810nm, 940nm, and 1060nm, or 755nm, 810nm, 940nm, and 1060nm). Unfortunately, the ruby laser at 694nm which was the first laser in hair removal with good results in skin types based on Fitzpatrick I and II, is not used due to the complications it caused to other skin types (Fitzpatrick>II) [6,13,14].

So, there are laser devices that emit two, three, and four wavelengths at the same time, as a result, aestheticians and dermatologists who use lasers, can use one device for all skin types (I-VI).[9] Also, all modern laser devices provide simultaneous skin protection and reduce pain, redness, and burns with modern cooling systems provided in parallel with the application of the laser. This is achieved with the device Zimmer that is incorporated into an Alexandrite Laser and/or ND: Yang Laser or with a built-in cryogenic air cooling system on the same laser device. A modern diode laser system provides simultaneous cooling of the head (Tec method - electric ceramic cooling element) through cooling sapphire. In addition, there are lasers with multiple handpieces (spot sizes) and handpieces with scanners in one device that allow for extension for different aesthetic problems. All modern lasers have a touchscreen, and ready programs depending on the characteristics of hair growth and color, skin color, etc. Finally, there are lasers with faster speed than lasers in the past (SHR / SAFE by fast, etc) [9,15,16].

Lehavit A., J et al. published the results of their study on the multiple wavelength laser evaluation and effectiveness (755nm, 810nm, 1064nm with Soprano Titanium, Caesarea, Israel: Alma Lasers Ltd). The parameters they used were Fluence 7-9J/cm^2, F = 9-10Hz, SS 2CM^2 or 4cm^2 for 6 treatments per 6-8 weeks, and the results were monitored after 4-6 months from the latest laser treatment. The eleven volunteers (n = 11) had Fitzpatrick skin type III-V. The results were evaluated with 3.4 / 4 on the GAIS and the average was 4.8 scale in the gratification rate of volunteers. No complications were recorded and concluded that these three wavelengths are a safe and effective laser treatment. Corresponding studies exist for all combinations of wavelengths but there was a lack of literature in comparative studies (e.g. two wavelengths with three wavelengths, or a multiple wavelengths with two wavelengths, etc) [15].

5. LASER SKIN RESURFACING INNOVATIONS

Laser can be used to rejuvenate and restore damaged skin. Non-ablative lasers began to be applied to treat skin aging to reduce the complications caused by invasive lasers. Ablative lasers (CO^2, Er:Yag, Fraxionallaser), are used by doctors (dermatologists and plastic surgeons) while non-ablative are used by both doctors and aestheticians. Ablative lasers improve scars, wrinkles, pigment spots, etc [15].

On the other hand, for non-ablative lasers which are divided into high and low-level laser therapy, it is not needed recovery time is required and the complications of ablative lasers do not occur. The only downside is that more treatments are required and in some aesthetic problems they do not always deliver the desired results [3]. The method of action of non-ablative laser devices differs from laser to laser for the treatment of the aesthetic problems; the corresponding parameters of the device are selected. In low-level laser therapy are no innovations in aesthetic use but in ablative lasers, there are new systems of laser with multiple wavelengths for skin resurfacing [1,3,16].

6. LASER INNOVATIONS FOR FAT REDUCTION

Lipolysis can be achieved both with non-ablative techniques such as electrotherapy devices, non-ablative lasers, and no-needle mesotherapy and ablative techniques such as surgery (liposuction), ablative laser, and needle mesotherapy [17,18].

LLLTs improve the difficult problem of cellulite but have the disadvantage that are need more treatments than ablative lasers and are better to be combinate with other technologies for fat reduction [10]. Until 2015 there was no other non-invasive laser technology that resulted in the reduction of adipose tissue (apoptosis fat cells). In 2015, the FDA approved the first and only hyperthermic laser for non-ablative remodeling of

the body's contour [5]. The Sculpsure device (cynosure, Westford, MA) causes an injury to adipocytes due to immediate tissue heating. The device consists of four handpieces with a simultaneous cooling system at 15ºC that are placed and touched on the skin [12,18]. The energy of this laser increases the temperature of the tissues reaching 42 ° C to 47ºC resulting in permanent fat loss of 24%, which is achieved in each treatment. The epidermis is protected with a cooling system at 15ºC during treatment. The choice of 1060nm wavelength is vital to the success and safety of this device due to its particular affinity with adipocytes. As with other methods, a satisfactory decrease in fat volume is not always associated with weight reduction. The lipolysis with a diode laser 1060 nm is a well-tolerated method and the satisfaction rates of participants in several clinical studies were at least 90% [18]. It is important that the first studies have not shown significant changes in the serum lipid profile or liver chemicals after treatment with this laser. Because melanin is little targeting with this wavelength, it is safe to use in all skin types (Fitzpatrick I-VI). Ideal candidates are people without obesity wishing to improve areas of the body with fat deposition that are durable with diet and exercise.

[Figure 2]: Handpieces of diode laser (1060nm) - Treatment in a 30-year-old woman with fat of knees. (Achievement Material F. Biskanaki, 2020)

7. DISCUSSION

Nowadays, there are many laser devices to face with aesthetic facial and body problems. There is a great deal of evolution in the laser hair removal devices combining two, three, and four wavelengths with other innovations in the way it is implemented, resulting in a safer, more efficient, and quicker laser application [9,13]. Also, there is in lipolysisan innovation in laser technology applied by aesthetics for the apoptosis of adipocytes, but there are no innovations in low-level laser therapy for skin regeneration. Finally, there is a lack in the literature on the comparative studies between two, three, and four wavelengths. As a result, we cannot sum up the ideal kind of laser for laser hair removal, because, for every organism with its skin and hair color, the results are different. However, it is needed more studies about the multi-wave wavelength laser hair removal [9,19].

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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