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PHOTOTHERAPY WITH LOW POWER LASERS AND LEDS IN FACIAL REJUVENATION

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Abstract: Introduction: The area of aesthetics is one of the fastest growing markets in Brazil and in the world, so that the search for aesthetic treatments to combat facial aging grows daily and, with it, technological advances such as photonic therapy with the use of lasers and low-power LEDs, this is a non-invasive, painless therapy with no side effects and is used in various treatments, including facial rejuvenation, offering benefits from the proliferation of fibroblasts and, consequently, an increase in collagen production and of elastin. **Objective:** to analyze the effects of therapy using lasers and low power LEDs in the treatment of facial rejuvenation. **Materials and methods:** through a bibliographical review, where the scientific databases Scielo, Pubmed, Google Scholar, theses and books that address the subjects mentioned above were used, works between the years 2000 and 2022, published in Portuguese, were reviewed. The articles were compiled in a spreadsheet, regarding the authors, year and evaluations, seeking to assist in the analyzes carried out. **Result:** Phototherapy provides significant improvements in facial rejuvenation, such as viscosity, firmness and elasticity. **Conclusion:** the phototherapy technique with low frequency LEDs can be an effective alternative for the reduction of wrinkles, expression marks, sagging and stains, through chemical alterations, biomodulation and photothermolysis.

Keywords: Photonic Therapy; Lasers; LEDs; Facial rejuvenation.

INTRODUCTION

The area of aesthetics is one of the fastest growing markets in Brazil, and this is due to the fact that contemporary aesthetics have become, in addition to vanity and self-esteem, a determining factor in quality of life and health as it involves physical well-being, psychic and social (ABIHPEC, 2020). In this sense, the main factors that motivate people to seek facial aesthetic treatments are related to the concern with the prevention and treatment of aging (ARAÚJO, 2012).

Aging is a natural action that occurs in the human body as a result of different intrinsic and extrinsic factors. Intrinsic aging occurs due to a deficiency in DNA replication, in which cells essential for maintaining skin integrity undergo transformations in their structure. As an example, fibroblasts, which have impaired collagen and elastin synthesis (SILVA; HANSEN; STURZENEGGER, 2012).

Unlike aging due to extrinsic factors, which can be caused by exposure to ultraviolet rays, smoking and excessive use of alcoholic beverages, which cause vasoconstriction of the skin and decrease the production of fibroblasts and free radicals (FR), which cause damage to normal cells and, consequently, accelerate the aging process (HIRATA; SATO; SANTOS, 2004; TEIXEIRA et al., 2018).

The face is considered by many to be the individual's business card, as well as, the quest to preserve a youthful appearance grows every day in the aesthetics market; and, with that, the development of new technologies, such as phototherapy, which have become a relevant therapeutic proposal. As exposed by Oliveira, Augusto and Moreira (2018, p. 71), the significant increase in the area of scientific research and therapeutic proposals related to facial aging has grown in recent years, because the search for aesthetics, beauty, well -being and health in different age groups has also grown, especially due to the influence of the media,

culture and society (OLIVEIRA; AUGUSTO; MOREIRA, 2018).

In this sense, one of the therapies that can be used in the area of rejuvenation and treatment of facial aging is phototherapy (LOPES; PEREIRA; BACELAR, 2018). The rise of this market is attracting more and more professionals every day, among them biomedical professionals who work in the area of aesthetics, who have perfect training conditions to use photonic therapy procedures, since their academic and professional training base provides knowledge that allows this performance.

The use of photonic therapy for aesthetic purposes is a recent field of investigation, which confirms the need to be explored for a better foundation of the resources and techniques available to professionals in the area (ARAÚJO, 2012), which justifies the survey on the subject, since with greater knowledge on the subject, professionals can act more assertively.

MATERIALS AND METHODS

The study was carried out through a descriptive and exploratory research, which used the bibliographic review, in order to analyze what the scientific literature deals with regarding photonic therapy in facial rejuvenation and the use of lasers and low power LEDs. The scientific databases Scielo, Pubmed, Google Scholar, theses and books that address the research theme published between 2000 and 2022, in Portuguese, were used.

The selection was initially carried out by the titles, and then the reading of the abstracts. The descriptors used for the searches were: lasers and low power LEDs, facial rejuvenation, light therapy, phototherapy, photonic therapy. From the references found, those that evaluated the action of low power laser on biological tissues, and those that presented results in the studies, were selected.

THEORETICAL REFERENCE

LASERS AND LEDS

The low-power laser originated in the 1970s and was created by the Hungarian physician and professor Endre Mester, with the aim of assisting in the healing of wounds and open ulcers by stimulating tissue healing (OLIVEIRA et al., 2014).

Laser is a type of electromagnetic radiation visible to the human eye (Figure 1); the abbreviation of the English expression "Light amplification by stimulated emission of radiation", which means the amplification of light by stimulated emission of radiation (MOREIRA et al., 2009). Therefore, it must be noted that, unlike sunlight and incandescent lights, laser light has different characteristics. They are:

> 1) coherent: waves are in phase in time and space; 2) monochrome: have the same wavelength (pure light, the same color); 3) collimated: the waves have the same direction, the light is parallel, not divergent, strict, concentrated, 1 nm in diameter;/ 4) it is a high intensity light (PINHEIRO, 2019, p. 14).

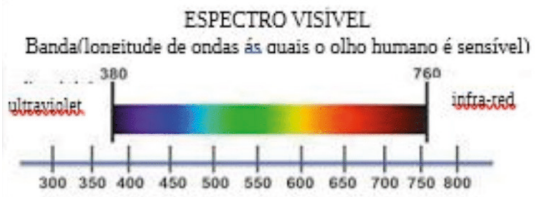

Figure 1: Spectrum visible to the human eye.

Source: E-disciplinas USP (2018)

In this perspective, it must be noted that low power lasers do not cause thermal damage, but result in photochemical, photophysical and/or photobiological processes when there is interaction with cells or tissues. According to Amorim (2007), biological tissues have chromophores, which are substances that absorb light, such as: melanin, hemoglobin,

hemomolecules, porphyrins, cytochrome oxidase, among others. When these biological tissues absorb laser light, the result is the production of a stimulus or an inhibition of enzymatic actions and metabolic reactions, which bring different therapeutic effects to the body (AMORIM, 2007).

LED light is the abbreviation of the English term "Light Emitting Diode", which refers to the production of a narrow spectral band of broad spectrum. efficient and effective in the treatment of physiological and pathological conditions, in addition to offering a better cost-benefit ratio (GOBBATO, 2010).

The wavelength of LED lights ranges from around 405 nm (blue LED) to 940 nm (infrared LED) and they are constituted as semiconductor diodes. Its action based on photomodulation acts directly on the permeability cells which, in turn, act on the mitochondria, which produce stimuli in the synthesis of ATP and proteins, such as collagen and elastin. Because of their direct intracellular stimulation on mitochondria, LED lights reorganize cells during their action (TAMURA; TAMURA, 2007).

In recent years, it is possible to notice a considerable growth in research on therapies capable of postponing facial aging.

In this perspective, there are several therapeutic proposals for this purpose, among them, it is possible to highlight phototherapy (MOREIRA et al., 2009).

Phototherapy is a therapy using lasers and low power LEDs that has been gaining ample space in the area of aesthetics, its benefits are notorious in several aesthetic treatments, among them, it is possible to highlight facial rejuvenation (ARAÚJO, 2012).

Light is a non-invasive and painless resource that provides positive results and these results without side effects that promote the proliferation of fibroblasts, that is, with its use there is a greater synthesis of collagen, still producing antioxidant, bactericidal and increased effects. of mitochondrial metabolism, stimulating DNA synthesis (OLIVEIRA; AUGUSTO; MOREIRA, 2018).

Figure 2: Photonic therapy in facial rejuvenation

Source: Portal Bio Cursos (2022).

In this sequence, it must be noted that phototherapy is made up of different lights that include both lasers and LEDs, as they have the attribute of biomodulating cellular responses, increasing cellular energy production (ATP) and controlling unwanted inflammation. The wavelengths are most often related to their color which sometimes include blue light ranging from 450 to 495 nm, green from 495 to 570 nm, amber or yellow from 570 to 590 nm, orange from 590 to 620 nm, red from 620 to 750 nm, and infrared from 750 to 1200 nm (COSTA; LIZARELLI, 2020), as exemplified in Figure 3.

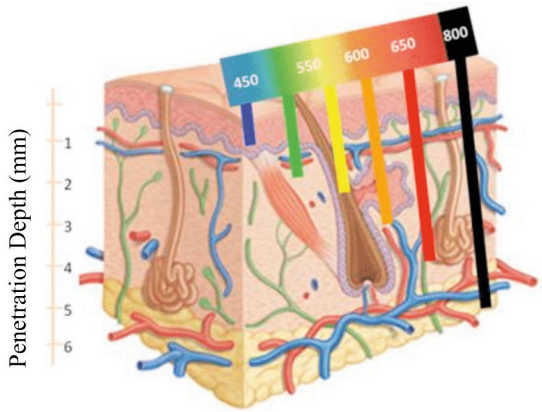

Figure 3: Light penetration as a function of different wavelengths in the skin.

Source: MMO Technology for Health (2020)

According to Bagnato et al. (2014), a factor to be considered in phototherapy is the appropriate wavelength. Said wavelengths are referred to by their color and include the therapeutic window: blue light (450-495 nm), green (495-570 nm), amber or yellow light (570-590 nm), orange light (590-620 nm) and red (620-750 nm) and near infrared (750-1200nm). The longer the wavelength, the greater its penetration into the skin, which is why red and infrared are used for the physical rehabilitation process, as infrared reaches maximum penetration (BAGNATO et al., 2014).

Phototherapy is a treatment performed with the use of laser and LED lights, in which, through light, it is possible to perform cell activation through photophysical, photochemical and photobiological effects. Biological tissues have substances that absorb light and are called (chromophores), which in contact with light produce enzymatic stimulation or inhibition and photochemical reactions. The action of this light takes place in the permeability cells and, in turn, in the mitochondria, stimulating the synthesis of ATP, and in the fibroblasts that are collagen and elastin precursor cells (OLIVEIRA; AUGUSTO; MOREIRA, 2018).

In this perspective, it must be noted that the photomodulation resulting from this light act on the permeability cells which, in turn, act on the mitochondria, which stimulate the synthesis of ATP, and on proteins, such as collagen and elastin. For this reason, its action happens due to direct intracellular stimulation in the mitochondria, performing cellular biomodulation (TAMURA; TAMURA, 2007).

Trelles (2005) states that this biomodulation offers potential improvement to the action of cells in the skin. That is to say, it reaches different and diverse cells from macrophages, endothelia and fibroblasts, increasing blood vessels and lymphatic flow with non-invasive and non-thermal methods.

In this sense, the Laser has characteristics widely described as monochromaticity, coherence and collimation, which allows its focused and precise use, in addition, equipment classified as low power does not have ablative action (OLIVEIRA; AUGUSTO; MOREIRA, 2018).

On the other hand, the LED light system is a light source that produces expressive results in facial aging treatments. Its performance takes place through a device with light emitters of different colors, namely: blue, amber, red and infrared (MANOEL; PAOLILLO; MENEZES, 2014).

LED equipment (acronym for Light Emitting Diode) are semiconductor diodes that, when subjected to an electric current, emit light (OLIVEIRA; AUGUSTO; MOREIRA, 2018).

Due to the technological progress experienced in recent decades, the benefits of phototherapy have also been observed in the dermatological area, allowing for better efficacy in treatments. Some scientific studies have observed the effect of various wavelengths on the proliferation of fibroblasts, verifying that the laser with wavelengths from 540 nm and from 600 nm to 900 nm accelerated the mitosis of these cells, thus increasing the speed of production of collagen and fibroblasts (LINS et al., 2010). On the other hand, these effects can also be observed in relation to LED, which has characteristics similar to laser, stimulating the production of endothelial cells and angiogenesis, in addition to the production of fibroblasts (BAGNATO et al., 2014).

Furthermore, Bagnato et al. (2014) highlights some specifications about the lights, regarding the wavelength range, layers of action on the skin, mechanism of action/physiological effect on the skin and indicated treatments (Chart 1; Chart 2. Chart 3).

RANGE OF WAVELENGTH/ COLOR	SKIN LAYER
450-495 nm BLue	Corneal extract, superficial epidermis and epidermis
570-590 nm Amber or Yellow	Stratum corneum, epidermis, dermis-epidermis junction, papillary dermis
620-750 nm Red	Corneal extract, epidermis, dermis and epidermis junction, papillary and reticular dermis
750-1200 nm Near Infrared	Corneal extract, epidermis, dermis-epidermis junction, papillary and reticular dermis, adipose tissue

Chart 1: Wavelength range and skin layer reached

Source: Bagnato *et al.* (2014) (adapted by the author)

RANGE OF WAVELENGTH/ COLOR	MECHANISM OF ACTION / PHYSIOLOGICAL EFFECT ON THE SKIN
450-495 nm Blue	Destruction of bacteria and fungi by light (activation by the porphyrin of the microorganism itself). Photoactivation of the skin's keratin, strengthening the skin's protection barrier, preventing water loss from the skin, leaving it more hydrated. Degradation of chromophores present in the skin reducing spots.
570-590 nm Amber or Yellow	Degradation of chromophores present in the skin reducing spots. Activation of collagen synthesis and remodeling in the superficial papillary dermis.
620-750 nm Red	Activation of the synthesis and remodeling of collagen, elastin, membrane proteins, among others, in the papillary and reticular dermis. Biostimulatory and biomodulating effects with anti--inflammatory and analgesic action, in addition to accelerating tissue repair.
750-1200 nm Near Infrared	

Table 2: Wavelength range and its physiological effect on the skin

Source: Bagnato *et al.* (2014) (adapted by the author)

RANGE OF WAVELENGTH/ COLOR	AESTHETIC TREATMENT INDICATED
450-495 nm Blue	Treatment of acne and conditions caused by bacteria and fungi. Treatment for skin hydration and strengthening of the skin's protection barrier against aging processes. Treatment of skin spots.
570-590 nm Amber or Yellow	Treatment of skin spots. Treatment of wrinkles and lines. Treatment of more superficial stretch marks.
620-750 nm Red	Facial rejuvenation, treatment of wrinkles and lines, elasticity and firmness Facial rejuvenation, treatment of wrinkles and lines, elasticity and firmness of the skin. Treatment of superficial and deep stretch marks, as well as localized fat and cellulite. Pain relief treatments with analgesic and anti-inflammatory effect, in addition to accelerating tissue repair
750-1200 nm Near Infrared	

Table 3: Wavelength range and indicated aesthetic treatment

Source: Bagnato *et al.* (2014) (adapted by the author)

The area of histology, which investigates the microscopic structure, composition and function of living tissues, has carried out different studies that reveal that the infrared laser, when used in the treatment of aging based on phototherapy, contributes to the increase and homogenization of collagen (OSÓRIO; TOREZAN, 2002). This increase and homogenization of collagen as a result of phototherapy with laser extends to approximately 6 months, after 4 sessions of clinical treatment, because they promote a moderate and significant reduction of the signs of skin aging (OSÓRIO; TOREZAN, 2002), as exemplified by Figure 4.

Figure 4: Result of facial rejuvenation with phototherapy

Source: Inspire Saúde (2022).

Corroborating the understanding exposed by Osório and Torezan (2002), Araújo (2012) also states that these lasers can also be used to promote the reduction of wrinkles and tissue sagging. This is because the laser light emitted this way is absorbed by chromophores, by oxyemboglobin and by deoxyhemoglobin, which results in a thermal effect that can stimulate collagen without harming microcirculation (ARAÚJO, 2012; OSÓRIO; TOREZAN, 2002).

In addition to what has been exposed so far, histology also indicates that, when lasers are used with a short pulse and energy of 6 to 7 j/cm², they can contribute to collagen thickening and to the increase of extracellular proteins, reducing the periorbital wrinkles with only one clinical treatment.

Figure 5: Result of facial rejuvenation with phototherapy

Source: Inspire Saúde (2022).

To exemplify the effectiveness of phototherapy in the aesthetic treatment of aging, it is worth mentioning the double-blind study carried out by Seung et al. (2007), in which LED was applied to 76 patients in the right half of the face for 3 months, with the frequency of their treatment sessions per week. Based on the research carried out by the author, it was possible to observe a significant reduction in wrinkles and an increase in elasticity in patients (SEUNG et al., 2007).

The author divided the patients into four groups, in which the first received a dose of 830 nm, the second received 633 nm, the third group received a combination of 830 nm and 633 nm, and finally, the fourth group received a placebo light (SEUNG *et al*., 2007). According to the histological evaluation of the research results by Seung et al. (2007), it was possible to detect a significant increase in the amount of collagen and elastic fibers in all groups of patients, revealing highly activated fibroblasts, surrounded by elastic and collagen fibers in an expressive number (SEUNG et al., 2007).

Figure 6: Result of facial rejuvenation with phototherapy

Source: Inspire Saúde (2022).

In this perspective, it is also worth highlighting the results of Estrela et al (2014) in their study on the effect of LED on facial tissue sagging, which was carried out in 40

female volunteers aged between 35 and 55 years, in which it was possible to verify that the angulation of the nasolabial fold showed an increase in the right and left angle. Since that the measurement of the nasolabial folds on the left side was proved as statistically significant, as an effect of LED application.

Figure 7: Result of facial rejuvenation with phototherapy

Source: Inspire Saúde (2022).

Figure 8: Result of facial rejuvenation with phototherapy

Source: Inspire Saúde (2022).

In this sense, it is possible to identify the differences of each treatment, the care that must be taken after the treatment and some complications caused, depending on the laser to be used for facial rejuvenation.

Therefore, phototherapy with lasers and LEDs, which have been used in aesthetic medicine as a treatment resource for the signs of skin aging, are shown to be an excellent therapeutic resource, since they promote the facial rejuvenation in different aspects, including the reduction or remission of superficial and deep wrinkles, skin spots and tissue sagging (ABRANTES et al., 2016).

CONCLUSION

Due to the mentioned data, it is possible to conclude that photonic therapy, with the use of low power lasers and LEDs, is significantly effective in the treatment of facial rejuvenation. This is because the action of the lights takes place in the permeability cells and, consequently, in the mitochondria, stimulating the synthesis of ATP and proliferation of fibroblasts, increasing the collagen and elastin proteins, which promote firmness, elasticity and skin support.

Phototherapy, which uses low power lasers and LEDs, is non-invasive, therefore, painless and without side effects, constituting an admirable therapeutic resource for the treatment of signs of skin aging, due to the great demand for less aggressive treatments that reach satisfactory results.

For this reason, photonic therapy, due to its specificities, is shown to be a good alternative for promoting facial rejuvenation, including the reduction of superficial or deep wrinkles, tissue sagging and skin spots.

Although it is a therapy that presents satisfactory results in facial rejuvenation, there is still little literature that demonstrates visual results, such as before and after photos in their studies.

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