Clinical Dermatology: Research and Therapy

SCIENTIFIC LITERATURE

Research Article

Photobiomodulation and Photodynamic Cosmetic Therapy on Hair Growth: Case Report

Priscila Fernanda Campos Menezes*[1,2,4], Nelson Mauricio Junior[2], Rosimeire da Mata[2], Ana Carolina Urbaczek[1], Maria Cecilia da Costa Pinto[1,3], Alessandra Keiko Lima Fujita[1] and Vanderlei Salvador Bagnato[1]

[1]Instituto de Física de Sao Carlos (IFSC), University of São Paulo (USP), Brazil

[2]Dr Peel Cosmeticos, Araras-SP, Brazil

[3]Uniararas - Araras-SP, Brazil

[4]Belle la Pelle – Araras-SP, Brazil

ARTICLE INFO

Received Date: May 31, 2018
Accepted Date: December 18, 2018
Published Date: December 21, 2018

KEYWORDS

Photodynamic cosmetic therapy; Photocosmetic product; Alopecia; Laser Led; Cosmetics; Microneedling

Citation for this article: Priscila Fernanda Campos Menezes, Nelson Mauricio Junior, Rosimeire da Mata, Ana Carolina Urbaczek, Maria Cecilia da Costa Pinto, Alessandra Keiko Lima Fujita and Vanderlei Salvador Bagnato. Photobiomodulation and Photodynamic Cosmetic Therapy on Hair Growth: Case Report. Clinical Dermatology: Research and Therapy. 2018; 1(3):123

Corresponding author:
Priscila Fernanda Campos Menezes, Instituto de Física de Sao Carlos (IFSC), University of Sao Paulo (USP), Av. Trabalhador Sao Carlense, 400 - CEP: 13560-970; Sao Carlos - SP, Brazil; Email: priscilamene2015@gmail.com

ABSTRACT

Androgenetic alopecia is a hereditary condition form of hair loss in both men and women. Among the established treatments of alopecia, the treatment based on pharmaceuticals drugs and laser, both with well-established satisfactory results, stand out. The association of light (laser and/or LED) to conventional Cosmetic Procedures in the Treatment of Alopecia optimizes the results minimizing the need for the association of usual pharmaceutical drugs such as finasteride, dutasteride, and minoxidil that presents considerable side effects. Here we presented two case report using light (laser and/or LED) on alopecia treatment associated or not with professional photocosmetic products on the clinical procedure. In agreement with the results, the application of light to alopecia treatment optimizes the growing hair; but association of light with photocosmetic products, cosmetics that absorb light through its chromophores on its composition, optimize the results decreasing the number of professional growing hair treatment sessions. The photodynamic Cosmetic Therapy using photocosmetic can be useful since that increases the light absorption by hair and hair follicles; decreasing the hair loss and acting on hair reconstruction.

INTRODUCTION

Androgenetic alopecia is a hereditary condition form of hair loss in both men and women in which disruption of proper androgen signaling results in decreased proliferation of follicle epithelia and progressive miniaturization of terminal hairs on the scalp. Among the established treatments of alopecia, the treatment based on pharmaceuticals drugs and laser, both with well-established satisfactory results, stand out. The association of light (laser and/or LED) to conventional Cosmetic Procedures in the Treatment of Alopecia optimizes the results minimizing needs forvvassociation of usual pharmaceutical drugs such as finasteride, dutasteride, and minoxidil that presents considerable side effects. Here we presented some case studies using light (laser and/or LED) on alopecia treatment associated or not with professional photocosmetic products on the clinical procedure [1].

The absorption and penetration of light into the biological tissue are dependent on the wavelength and the chromophores in the tissue, able to absorb this light and then induce important photochemical processes in the cellular metabolism [2]. The androgenetic alopecia treatment using laser and/or LED are well grounded in the

literature. It can be said that the red light (Laser and/ LED) stimulates the hair bulb, increasing the cellular metabolism, resulting in a greater capillary nutrition and strengthening the hair strands also, consequently decreasing hair loss. In addition, red light stimulates the development of new hair follicles, by epidermal stem cells in the Hair Follicle (HF) activation [3-5], increasing the amount of hair on the scalp as well as decreasing the local inflammation induced by daily stress and cellular aging, consequently decreasing the increase in hair loss [1,4].

However, the blue light, which acts by activating the keratin present in the hair shaft, consequently leads to the alignment of the cuticles, increasing the water retention (hydration of the hair) (NIELSEN et al., 2008, 6]. Red light acts on cellular energetic metabolism when absorbed by cellular photoaceptors, such as the enzyme citrate synthase, NADH dehydrogenase and cytochrome C oxidase, which accelerate the transport of electrons in the respiratory chain of the mitochondria, increase energy synthesis [Adenosine Triphosphate (ATP) and make possible several therapeutic effects, such as alterations in DNA / RNA expression, anti-inflammatory action and regeneration of bone, muscle, neural tissue and, mainly, the cutaneous tissue [2]. This photobiostimulation leads to an increase in the proliferation of fibroblasts, with a consequent increase in the collagen, elastin, proteoglycan and other components of the extracellular matrix, as well as the increase of the blood vessels and the supply of oxygen and nutrients to the tissues, of metabolism and cellular renewal leading to the increase of the controlled cellular proliferation [2,7].

Photodynamic Therapy (PDT) applied in the aesthetic area can be called as Photodynamic Cosmetic Therapy (PDTc) and defined as a mixture between Phototherapy and Photodynamic Therapy behavior since that uses low power light radiation (mW) and low-medium light irradiation dose or fluence (J/cm2).

Photobiomodulation therapy is based on the light interaction with membranes and endogenous chromophores on the skin as melanin, hemoglobin, keratin, and others increasing the cell metabolism by Mitochondrial Biogenesis activation. As result of this the gene expression is increased and the production of the protein also [8,9].

PDT is based on light interaction with a photosensitizer or photoactive or endogenous photoactive, that absorbs light; and by photophysical and photochemical reaction transfers energy to oxygen on tissue; producing reactive oxygen species responsible for inflammatory response capable to stimulate the healing process on tissue (neocolagenese stimulation) [5,6,10-12].

Cosmetic technologies that potentiate and or optimize the interaction of light in the skin are current novelties in the cosmetic market. Photoactivated cosmetics or Photocosmetic are cosmetics products that contain photoactive or photosensitizer, with chromophore groups, which shows absorption bands in the electromagnetic spectrum region from the visible to the near-infrared [10].

In this context, the application of the Photodynamic Cosmetic Therapy aims to optimize the absorption of light on different skin and hair layers in the presence of photoactive, which absorb light at different wavelengths. In this sense, the inclusion of photoactive in cosmetic formulations aims to optimize light treatment. Knowing that the red light application in the alopecia treatment aims to promote the supply of oxygen and nutrients in the hair follicle, we can suggest for treatment photoactive that absorb light in the red wavelength (630-660nm), as methylene blue and Aminolevulinic Acid (ALA) and its derivative Methyl Aminolevulinate (M-ALA) as precursors of Protoporphyrin IX (PPIX) [3,13,14].

Also, the blue light application activates the keratin of hair strand and the scalp increasing the water retention favoring the hydration and strengthening of the hair strand in the hair bulb. In addition, the blue light acts in the microbiological control of fungi and bacteria as well as diminishes the hyperplasia of the sebaceous gland diminishing the grease of the scalp [2,6]. In this case, we can suggest for treatment photoactive as Curcumin and Aminolevulinic Acid (ALA) and its derivative Methyl Aminolevulinate (M-ALA) that absorb light in the blue wavelength (450-470nm). When talking about induction of a pro-inflammatory mechanism in the treatment of alopecia, we should consider the importance of dosimetry on photodynamic cosmetic therapy protocols. There is an irradiation dose threshold in the photobiomodulation that separates the mechanisms responsible for the photo stimulus, as well as mechanisms of photoinhibition that is directly related to

the generation of oxygen free radical species in excess, increasing the hair fall by destruction of the follicle and capillary grayishness (reduction of melanin as well as melanocyte cell destruction). In a deal the literature elevated light doses on hair scalp can destroy the follicle on bulge [15,16].

The photocosmetics products present chromophoresphotostable on its formulations capable to induce photophysical and photochemical mechanism to promote photobiological effects on the tissue [17-19]. The microneedling application on previously on once time a month procedure using photoactive and laser aim to optimize the penetration of actives on bulge area of the hair follicle, promoting hair growth increasing the effectivity on alopecia treatment (RODRIGUES et al., 2014).

The purpose of this study is showing that laser and /or LED light application can be useful on alopecia androgenetic treatment.

The association with Photocosmetic improves the results of hair treatment. It is possible to perform the Photodynamic Cosmetic Therapy on androgenic alopecia using red and blue light (laser and LEDs devices) in the presence of photocosmetics, which present photoactive that absorbs light in determined wavelength, improve the photodynamic reaction responsible by photodynamic efficacy on growth hair.

MATERIALS AND METHODS

Case presentation

Equipment

The laser and LED light treatment was done using commercial equipment called Venus (MMOptics - São Carlos-Brazil). The equipment shows red laser light on 630nm and blue LED light on 450nm. Also presents amber LED light and infrared laser light. In (Figure 1) the irradiation procedure can be observed.

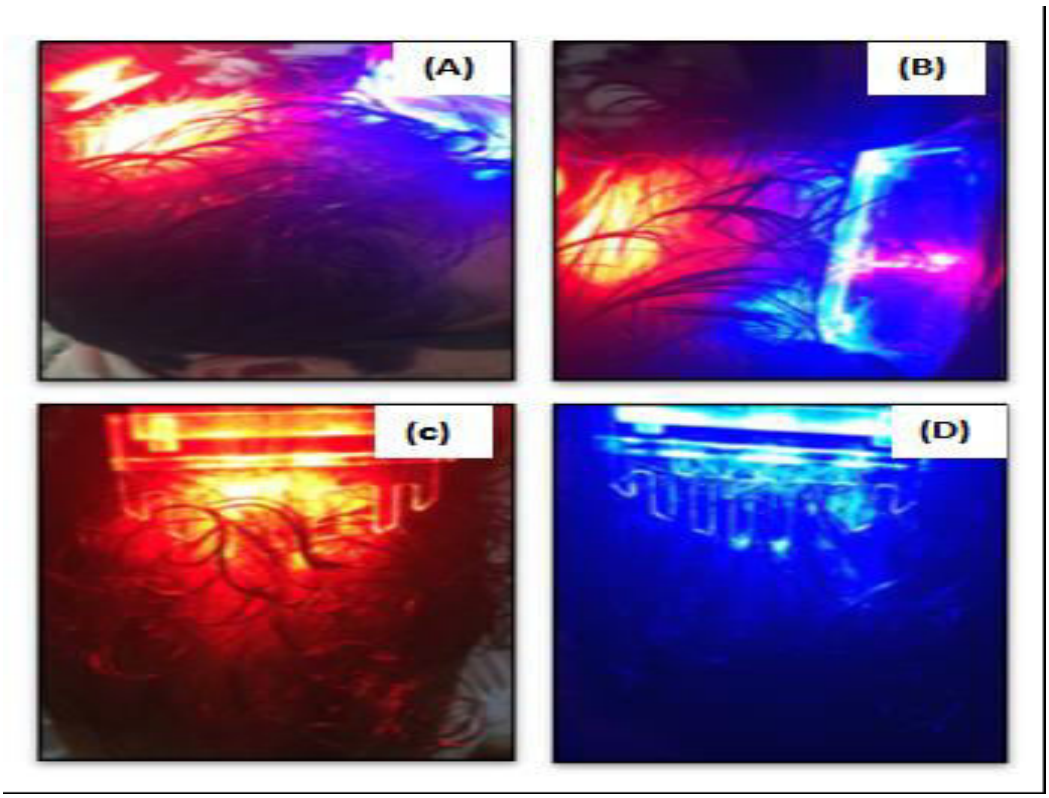

Figure 1: Androgenetic Alopecia treatment on the hair scalp (A,B) and on hair application using an acrylic comb coupled to the laser and LEDs system. The equipment used on study is called Venus (MMOptics – São Carlos- Brazil).

Professional cosmetic product

The commercial cosmetic product (photocosmetic) called Photoactive (Dr. Peel- Araras - Brasil) containing in its composition curcumin (0.5-1.5%) and methylene blue (0.05-1%) as chromophores that absorbs blue and red light respectively. Also shows cosmetic actives as caffeine, adenosine, growth factors and others that stimulates the vascularization (improves nutrition to hair follicle), angiogenesis and also decrease the levels of reactive oxygen species.

This product is used on professional alopecia treatment protocols as we can see on (Figure 3) ; using blue LED light with the light irradiation dose of 5J/cm2 and red laser light with the irradiation dose of 10J /cm2.

In the first case study, the treatment was performed on 15 weekly sessions during 120 days and in the second case study with 5 monthly sessions during the same time (120 days).

Volunteers

The case report for androgenic alopecia was carried withtwo male volunteer with 34 years old, healthy (without any concomitant disease), skin phototype III, with androgenic alopecia, characterized by elevated hair loss (Figure 2 and 3) and with over gray hair (Figure 2). The volunteers were clarified about the study and read and signed the informed consent, authorizing the accomplishment of the procedures. The patient report years of problems with many tries with conventional therapy without satisfactory results.

For both case report treatment the laser and LED light device called Venus (MMOptics - São Carlos-Brazil) was used.

The volunteer one (Figure 2) was submitted to Photobiomodulation Therapy sessions using laser and LEDs on fifteen weekly sessions and in the second case the volunteer two (Figure 3) was submitted to Photodynamic Cosmetic Therapy sessions using laser and LEDs in the presence of one commercial cosmetic (photocosmetic) called Photoactive (Dr Peel- Araras -São Paulo) with five monthly sessions. In both androgenic alopecia studies, the microneedling application was done previously on the procedure, once time a month on sessions aims to optimize the penetration of actives (tonic photoactivated "photoactive" or the same tonic not photoactivated(without curcumin and methylene blue as chromophores) andto stimulating the wound welling on bulge area of the hair follicle, promoting hair growth increasing the effectivity on alopecia treatment.

Cosmetic products home care

In both cases the volunteers applied frequently a tonic hair on home care daily, containing cosmetic actives that controlled the inflammation (antioxidants and soothing), which modulates the oil secretion and dihydroxytestosterone - DHT enzyme increased and also stimulates the angiogenesis increasing the number of vessels responsible by greater nutrition and oxygenation on hair-follicle as: caffeine, growth factor, capixyl, adenosine, capilia longa, prodizia.

In this study, the comparisons between professional Photobiomodulation Therapy and Photodynamic Cosmetic Therapy treatment was performed by visual image evaluations on androgenetic alopecia treatment after 30, 60 and 120 days as observed on (Figure 2 and 3).

RESULTS AND DISCUSSION

In (Figure 1) we observed the Androgenetic Alopecia treatment using red Laser and blue LED light. On the study carried out in (Figure 2) on Androgenetic Alopecia treatment were applied using Blue LED light with the light irradiation dose of 5J/cm2 and red laser light with the light irradiation dose of 10J/cm2 on fifteen weekly sessions. Cosmetic products were applied to home care during treatment time. The cosmetic product (capillary tonic) used on home care, containing cosmetic actives that control the inflammation (antioxidants and soothing), that modulates the dihydrotestosterone – DHT and stimulates the angiogenesis (increasing the number of vessels) responsible for greater nutrition and oxygenation on scalp hair. In agreement with the results, the Photobiomodulation Therapy using red and blue light improves the alopecia treatment as well as decrease the gray hair.

In the (Figure 3) we observed the study of Androgenetic Alopecia treatment using Blue LED light with light irradiation dose of 5J/cm2 and red laser light associated with one photocosmetic product (Photoactive - Dr. Peel) on five monthly sessions.

In agreement with the results on (Figure 2) and (Figure 3) is possible to conclude that the laser and LED treatment has an influence on growth hair and on decreasing on gray hair as we can observe on (Figure 2). The influence of red laser light on

Photobiomodulation and Photodynamic Cosmetic Therapy on Hair Growth: Case Report. Clinical Dermatology: Research and Therapy. 2018; 1(3):123.

hair growth is known however the association with blue LED light is until now is not known. In the case, the blue led light promotes a microbiological control, oil control and acts increasing the hydration on follicle since that normalized the keratinization process on hair scalp. Then, the association of red laser and blue LED light application on treatment has to influence on decreasing of hair loss.

In the first case on (Figure 2), the treatment can be defined as Photobiomodulation therapy where the treatment sessions are performed only in the presence of light (laser and LEDs). As we can see the growth hair and decrease of gray hair happen from weekly sessions number eight (after 60 days). At the final session (session fifteen) is possible to observe the differences on hair in amount, color (now black), on strength and structuring of strand hair.

On (Figure 3) the association of photocosmetics on treatment now defined as Photodynamic cosmetic Therapy are performed using previously photocosmetics on hair scalp (around ten minutes) before the light irradiation using laser and LEDs devices. The growth hair can be observed from monthly sessions number three (after 60 days). After 120 days the differences in hair amount can be evaluated. Comparing the results on (Figure 2) and (Figure 3) is possible to suggest that the presence of photocosmetics, responsible by light absorption increased, the alopecia treatment was optimized. Photocosmetics products are cosmetic products that present photoactive as curcumin and methylene blue that absorb light in specific wavelengths increasing the absorption of light by skin and hair but also cosmetic ingredients important on alopecia treatment. The presence of photocosmetics products on professional alopecia treatment (Photodynamic cosmetic therapy on alopecia treatment) decreases the number of treatment sessions and the interval between them.In the first case study, the treatment was performed on 15 weekly sessions during 120 days and in the second case study with 5 monthly sessions during the same time (120 days). The results found to prove that the presence of photocosmetics products decreases around three folds the session's number.Also in both case, the cosmetic products were used in home care.

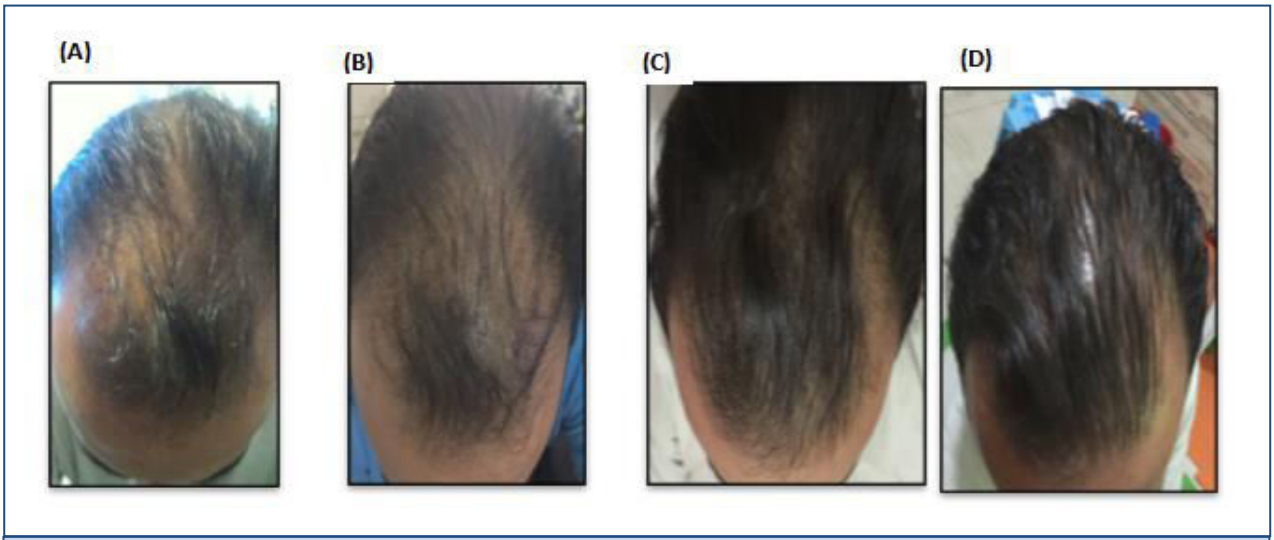

Figure 2: Photobiomodulation Therapy on Androgenetic Alopecia using Blue LED light with irradiation dose of 5J/cm2 and RED laser light with light irradiation dose of 10J /cm2 using the equipment called Venus (MMOptics - São Carlos - Brasil) on 15 weekly sessions. The microneedling application was done previously on procedure, once time a month on sessions, using photo actives and laser aims to optimizing the penetration of actives on bulge area of hair follicle. A) Picture on Initial session, B) Picture on session number 4 (after 30 days), C) Picture on session number 8 (after 60 days) and D) Picture after session number 15 (after 120 days). Source: Own Author.

Photobiomodulation and Photodynamic Cosmetic Therapy on Hair Growth: Case Report. Clinical Dermatology: Research and Therapy. 2018; 1(3):123.

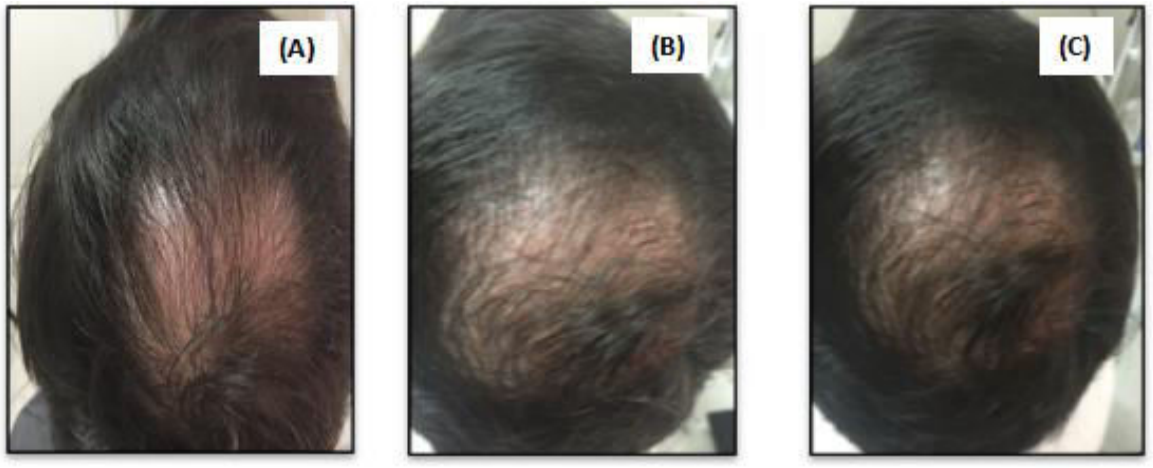

Figure 3: Photodynamic Cosmetic Therapy on androgenetic alopecia using Blue LED light with irradiation dose of 5J/cm2 and RED laser light with light irradiation dose of 10J /cm2 using the equipment called Venus (MMOptics -São Carlos - Brasil) associated with one photocosmetic product (Photoactive - Dr. Peel) on five monthly sessions. The microneedling application was done previously on procedure to optimize the penetration of actives on bulge area of hair follicle. A) Picture on Initial session, B) Picture on session number 3 (after 60 days), C) Picture on after session number 5 (after 120 days). Source: Own Author.

CONCLUSION

The results obtained in the present study suggest that Photodynamic Cosmetic Therapy using photocosmetic products associated to laser and LEDs devices is effective on alopecia treatment. The results found by Photobiomodulation Therapy also is effective however the Photodynamic Cosmetic Therapy optimizing the light absorption by skin and scalp hair decreasing the number of sessions of treatment optimizing the alopecia treatment. The cases reported here are important to understanding the benefits of light on hair growth and decreasing of gray hair.

REFERENCES

1. LanzafameRJ,Blanche RR,Bodian AB,Chiacchierini RP,Fernandez-Obregon A, et al. (2013). Lasers Surg Med. 45: 487-495.
2. Hamblin MR. (2016). Photobiomodulation or low-level laser therapy. J Biophotonics. 9: 1122-1124.
3. Carrasco E,Calvo MI,Blázquez-Castro A,Vecchio D,Zamarrón A, et al. (2015). Photoactivation of ROS Production In Situ Transiently Activates Cell Proliferation in Mouse Skin and in the Hair Follicle Stem Cell Niche Promoting Hair Growth and Wound Healing. Journal of Investigative Dermatology, 135: 2611–2622.
4. Santos Z, Avci P,Hamblin MR. (2015). Drug discovery for alopecia: gone today, hair tomorrow. Expert Opin Drug Discov. 10:269-292.
5. Menezes PFC, Requena MB,Lizarelli RFZ,Bagnato VS. (2015). Blue LED irradiation to hydration of skin. Proc. of SPIE – The International Society for Optical Engineering. 9531.
6. Menezes PFC, Carbinatto FM, Pinto MC. (2015). Terapiafotodinâmicanaestética. .. TerapiaFotodinâmicaDermatológica: Programa TFD Brasil.. 999ed.São Carlos:Compacta. 1: 249-262
7. De Freitas IF, Hamblin MR. (2016). Proposed Mechanisms of Photobiomodulation or Low-Level Light Therapy. IEEE J Sel Top Quantum Electron. 22: 7000417.
8. Castano AP, Demidova TN, Hamblin MR. (2005b). Mechanisms in photodynamic therapy: part two-cellular signaling, cell metabolism and modes of cell death. PhotodiagnosisPhotodynTher. 2: 1-23.
9. Gracielli Sousa R, Phamilla De Menezes, Priscila FC, Fujita Alessandra KL, Requena Michelle B, et al. (2014).Microneedles rollers as a potential device to increase ALA diffusion and PpIX production: evaluations by

wide-field fluorescence imaging and fluorescence spectroscopy.

10. Castano AP, Demidova TN, Hamblin MR. (2005a). Mechanisms in photodynamic therapy: part one-photosensitizers, photochemistry and cellular localization. PhotodiagnosisPhotodynTher. 2: 91-106.
11. Menezes PFC,Requena MB,Bagnato VS. (2014). Optimization of Photodynamic Therapy Using Negative Pressure. Photomedicine and Laser Surgery. 32: 296-301.
12. Menezes PFC, Manoel CA, Paolillo FR. (2014). Conceitos Fundamentais e Práticos da Fotoestética.. 1. ed. São Carlos: Compacta Gráfica e Editora. v. 1. 141p .
13. Rodrigues PG, Campos de Menezes PF, Fujita AK, Escobar A, Barboza de Nardi A, et al. (2014). Assessment of ALA-induced PpIX production in porcine skin pretreated with microneedles. 8: 723-729.
14. RequenaMichelle Barreto, CuryTherezaFortunato, Vollet-Filho José Dirceu, GreccoClóvis, Kurachi Cristina. (2015). Theeffectivity of ALA-PDT using IPL evaluated by image and histological analysis using porcine skin models in vivo. Photodiagnosis and Photodynamic Therapy. 12: 347-348.
15. Shin H,Yoon JS,Koh W,Kim J,Kim CH, et al. (2016). Nonpigmented hair removal using photodynamic therapy in animal model. Lasers in Surgery and Medicine. 48: 748-762.
16. Pinto MCC,Fujita AKL,Menezes, PFC.(2017). BAGNATO, V.S. Photodynamic Therapy with 5-Aminolevulinic Acid (ALA) in the Treatment of Acne: A Case Study. ClinDermatol Res Ther. 1:114.
17. Menezes PFC, Bernal C, Imasato H, Bagnato VS, Perussi JR. (2007). Photodynamic activity of different dyes. Laser physics. 17: 468-471.
18. Ferreira J, Kurachi C,Moriyama LT, Menezes PFC, Perussi JR, et al. (2005). Correlation between the photostability and photodynamic efficacy for different photosensitizers. Laser Physics Letters 3: 91-95.
19. Ferreira J, Menezes PFC, Kurachi C, Sibata CH, Allison RR, et al. (2007). Comparative study of photodegradation of three hematoporphyrin derivative: Photofrin®, Photogem®, and Photosan® .Laser Physics Letters 4: 743.