

## The Use of LED for Acne Treatment

**Yamada FR<sup>1\*</sup>, da Silva MM<sup>1</sup> and Scasni KR<sup>2</sup>**

<sup>1</sup>Academic in Physiotherapy Course of University São Francisco, Bragança Paulista, SP, Brazil

<sup>2</sup>Prof. Sc. M. in Physiotherapy Course of University São Francisco, Bragança Paulista, SP, Brazil

### Research Article

Volume 2 Issue 1

Received Date: May 23, 2018

Published Date: May 31, 2018

**\*Corresponding author:** Felipe Ryuichi Yamada, Academic in Physiotherapy Course of University São Francisco, Bragança Paulista, SP, Brazil, Email: feliperyuichi@hotmail.com

### Abstract

**Background:** New modality of treatment for acne is the use of Light Emitting Diodes (LEDs), wavelength 405nm (blue light) to 940nm (infrared light). Blue light is indicated for acne treatment for bactericidal action, thus amber light is indicated for metabolism action.

**Objectives:** Analyse the effects of blue LED plus amber LED compared with isolated blue LED in acne treatment.

**Methods:** A blind and randomized clinical trial, both sexes, aged 18 till 40 years old, subdivided in group 1 (blue LED, 16' session) and group 2 (blue plus amber LED, 32'), treated for 6 sessions, using specific questioners to psychosocial evaluation, reduction lesions number and evaluation developed by the researchers.

**Results:** A total of 10 subjects, obtaining improvement in psychosocial impact decreased 1,7, facial perception decreased 2,1 and lesions count, 60% mild improvement and 10% moderate improvement. Conclusion: It is observed that the use of LED technology for acne approach is effective to both groups, as much in self evaluation of improvement as in remission of lesions number, being a secure and effective therapy for acne management.

**Keywords:** Skin; Acne Vulgaris; Laser; Light; Phototherapy; Physical Therapy Specialty; Psychosocial Impact

### Background

Acne is one of the most common diseases of sebaceous glands and hair follicle affecting the teenager population in the boom of androgenic hormones release that regulate the sebaceous secretion [1,2].

The focus of the dermatologic treatment is to reduce the bacteria colonization and decrease the obstruction in the pilosebaceous complex, the market has different

treatments for the management of this pathology, by the use of drugs and active principles [3,4].

New modality of treatment for acne is the use of Light Emitting Diodes (LEDs), semiconducting diodes that receive an electrical current that leads to light emission. The LEDs have wavelength 405nm (blue light with superficial absorption) to 940nm (infrared light with profound absorption). Blue light is commonly indicated for acne treatment for bactericidal action, thus amber

light is indicated for metabolism action and anti-inflammatory effects [5,6].

According to Meyer et al. phototherapy by the use of LEDs receives the name of photo stimulation works with light in wavelength 405nm (blue light) to 940 (infrared light). Being effective against acne due to endogenous release of the photosensibilizing coproporphyrin III (produced by acne most common bacteria, *P. Acnes*) as observed in by Lee et al. e Ashkenazi et al, soon the use of antibiotics in this approach wouldn't be indicated since this therapy depends of the production of that porphyrin by the bacteria [7-10].

The energy that comes from LEDs light acts directly through cells (cell membrane permeability), its organelles (mitochondria), its proteins (collagen and elastin) and its physiologic process (ATP synthesis) [7].

The mechanism of action of LED through acne consists in excitation of great amounts of porphyrins (coproporphyrin III) that are produced and stored by *P. Acnes* that by absorbing this energy generates photosensibilization against the bacteria. The porphyrins when get in contact with irradiation of visible light transform itself in excited state following with producing and releasing singlet oxygen that combines with cell membranes and ends decimate *P. Acnes*, this mechanism depends of the quantities of porphyrines present (greater the number of porphyrins greater will be the quantity of porphyrins excited by visible light and greater its bacteria eradication) as well as photons quantity, its temperature and wavelength of photons [9,11].

Leyden et al. observed in his clinical Trial that blue light and blue light combined with red light have superior efficacy in the treatment of inflammatory acne mild and moderate degree when compared with topic use of clindamicin, however presented lower when compared to association of clindamicin plus benzoil peroxide [12].

In Ashkenazi et al. cultures of *P. Acnes* bacteria were carried out observing that coproporphyrin III was found in both groups [9]. Afterwards the cultures were exposed into blue light (407 to 420nm) for 24 hours and it was noted that only one exposition to light wasn't enough to a viable reduction of *P. Acnes* magnitude, being necessary three to four expositions (of 48 hours and 72 hours respectively) in order to obtain an expressive reduction of *P. Acnes* magnitude, suggesting that several irradiation of blue light (407 a 420nm) in patients treated with acne vulgaris can generate positive results in these individuals.

In a blind clinical randomized trial Papageorgiu et al. the group that received the blue light combined with red light improved in 76% of inflammatory lesions when compared to the other groups [13]. When analysed the presence of black heads (comedones) the group blue light associated with red light got better, although wasn't observed statistically results. Concluding that the synergic combination of both lights (blue and red) are effective to work as bactericidal and anti-inflammatory respectively, being an elective, safe and effective treatment for acne.

Therefore, according with consulted literature the following research objectives to analyse the effects of blue LED associated to blue light and compare with isolated use of blue light, for acne treatment.

## Methods

Clinical Trial randomized one blind. The research was performed in Physiotherapy's Course Clinic School of University São Francisco Campus Bragança Paulista – SP – Brazil, counting with two researchers and one assistant.

Fifteen volunteer were interviewed for the research and these ones were evaluated according to inclusion criteria, individuals with acne till grade II classified by Holmes, age 15 to 40 years old and according to exclusion criteria, grade I acne; treatment of acne in the last three months (benzoil peroxide, topic retinoids, topic antibiotics, salicylic acid and azelaic acid) and the use of systemic (oral antibiotics, contraceptives, antiandrogenic and oral retinoid); use of oral antibiotics; less than five inflammatory lesions; severe acne and pregnancy, ending with total of 10 subjects [6].

After the assortment the volunteer received and signed the Consent Form (CF), approved by Ethics Committee in Research of University São Francisco by the number 1.757.915.

The subjects were distributed into two groups, randomized by the use of numbered letter envelopes, its content was as unknown for the subjects as for the researcher evaluator, each individual selected one letter envelope and was destined to the group 1 indicated by letter envelope 1 (blue LED isolated) or group 2 by letter envelope 2 (blue LED associated to amber LED).

The treatment was performed in two week sessions, with duration of 16 minutes of application in the group 1 and 32 minutes in the group 2 (16 minutes blue LED; 16 minutes amber LED), for the total of three weeks, total of 6 sessions.

The application of evaluation sheet developed by the researchers was fill in only in the first day of evaluation. The Cardiff Acne Disability Index CADI – Translation, cultural adaptation and validation for Brazilian Portuguese of the Cardiff Acne Disability Index instrument – CADI was applied in the first intervention and in the last but one [14]. The Inflammatory Spot Counts ISC and Visual Scale of Facial Perception VSFP15 was both applied in the first, third and fifth session successively [13]. The data obtained by ISC were classified according to improves (decrease) or worsens (increase) number of lesions, classified as, worse ( $\leq -10\%$ ), unchanged (-9-9%), mild improvement ( $\geq 10-39\%$ ), moderated improvement ( $\geq 40-59\%$ ) and marked improvement ( $\geq 90\%$ ), method of classification used in the research of Papageorgiou, et al [13,15].

The procedure was performed with the patient in supine position on the stretcher, skin without using cosmetics, performing the application in 8 points with duration of 2 minutes per point, distributed in 1 point in frontal region, 1 point zygomatic region, 1 point in masseter region and 1 point in ment region, all bilaterally.

The equipment used was Fluence by HTM Electronics, power of 1500mW  $\pm 10\%$  distributed between three LEDs of 500mW, wavelength 470nm  $\pm 10\%$  in blue cluster and 617nm  $\pm 10\%$  in amber cluster, dose of 180J/cm<sup>2</sup> (1,5Watts x 120 seconds) per point, resulting in a total dosage of 1440J/cm<sup>2</sup> in group 1 and 2880J/cm<sup>2</sup> in group 2.

The data obtained was organized in a database (Microsoft Office Excel 2007 spreadsheet). Was performed descriptive analysis calculating frequency (%) for the qualitative variables (sex, coetaneous photo type and grade of acne) and calculating mean and standard deviation for the quantitative variables (Age, CADI, VSFP and ISC) the comparison of the variables was performed intergroups and intragroups by the statistic test Wilcoxon, Wilcoxon Mann Whitney and Fisher's exact test, with significance level of  $p < 0,05$ .

## Results

The data collect occurred in November/December 2016 and March/April 2017. The initial sample counted on 15 volunteers, three excluded for using contraceptive, one for grade 1 of acne and one for severe acne. Ten subjects were included in this research, middle age 21,5  $\pm 1,4$ , 50% (n=5) female and 50% (n=5) male, 30% (n=3) grade 2 of acne and 70% (n=7) grade 3 of acne, being statistically similar as to the variables described and

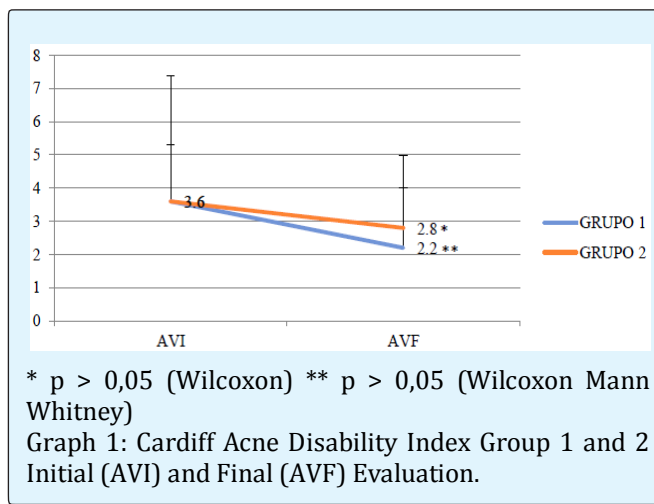
presented in table 1. In group 2, two participants missed appointments, all were replaced.

	Group 1 n (%)	Group 2 n (%)	p value
Age			0.748†
(mean $\pm$ SD)	21,6 $\pm$ 1,8	21,4 $\pm$ 1,1	
Median (min-max)	22 (19 - 24)	21 (20 - 23)	
Sex			0.500*
Male	03 (60)	02 (40)	
Female	02 (40)	03 (60)	
Phototype			1.000*
2	03 (60)	02 (40)	
3	02 (40)	02 (40)	
4	0 (0)	01 (20)	
Grade of Acne			0.500*
2	02 (40)	01 (20)	
3	03 (60)	04 (80)	

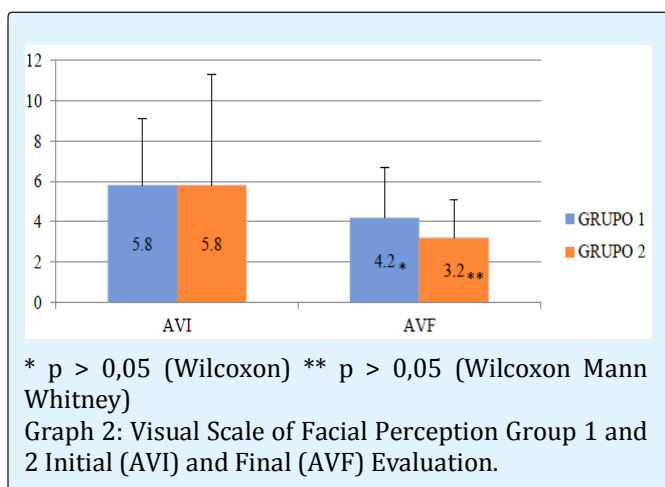
† Wilcoxon test; \* Fisher's Exact test.

Table 1: Characteristics of subjects divided into groups 1 and 2.

In order to qualitatively evaluate using subjective instruments, 2 were chosen. The first one was The Cardiff Acne Disability Index (CADI) – Translation, cultural adaptation and validation for Brazilian Portuguese, the group 1 obtained a decrease of 1,4; although not significant (Wilcoxon  $p = 0,454$ ). The group 2 also obtained a decrease of 0,8; although not significant (Wilcoxon  $p = 0,387$ ). When analysing all ten subjects was observed a score decrease of 1,7; considering that smaller the score smaller the psychosocial impact, however not significant initial stage (Wilcoxon Mann Whitney  $p = 0,527$ ) and final stage (Wilcoxon Mann Whitney  $p = 0,519$ ), expressed in graphic 1.



The second instrument was the Visual Scale of Facial Perception (VSFP), applied in three moments, at the beginning, throughout the treatment (middle) and at the end of treatment. The group 1 obtained the AV1  $5,8 \pm 3,3$ , AV2  $4,6 \pm 2,5$  and AV3  $4,2 \pm 2,5$  observing a decrease of 1,6 AV1 compared to AV3, expressive improvement although not significant (Wilcoxon  $p= 0,240$ ). The group 2 obtained AV1  $5,8 \pm 5,5$ , AV2  $4,4 \pm 2,1$  and AV3  $3,2 \pm 1,9$  observing a decrease of 2,6 AV1 compared to AV3, also expressive improvement although not significant (Wilcoxon  $p= 0,114$ ). When analysing all ten subjects AV1  $5,8 \pm 4,3$ , AV2  $4,5 \pm 2,2$  and AV3  $3,7 \pm 2,2$ , observing decrease of 2,1 AV1 compared to AV3. Expressive improvement in score of group 2 when compared to group 1, both groups obtained a gradual decrease of de values, considering that smaller the score greater the facial satisfaction, however not significant initial stage (Wilcoxon Mann Whitney  $p= 0,167$ ) e final stage (Wilcoxon Mann Whitney  $p= 0,750$ ), expressed in graphic 2.



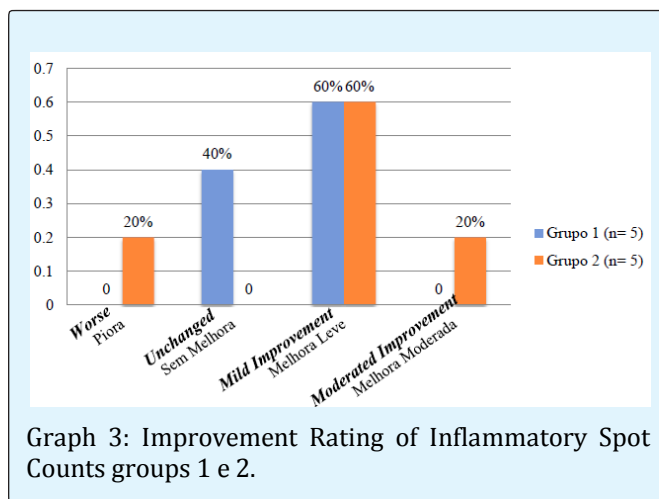
As for quantitative analysis was performed the Inflammatory Spot Counts (ISC) also realized in three different moments at the beginning, throughout the treatment (middle) and at the end of treatment. The group 1 obtained AV1  $15,0 \pm 11,1$ , AV2  $15,0 \pm 12,9$  and AV3  $11,6 \pm 7,6$ ; observing plateau between AV1 and AV2 and decrease of 3,4 score AV1 compared AV3, although not significant (Wilcoxon  $p= 0,671$ ). The group 2 obtained AV1  $20,2 \pm 9,0$ , AV2  $21,8 \pm 5,3$  and AV3  $16,2 \pm 3,1$ ; observing an expressive decrease of 3,8 score AV1 compared to AV3, although not significant (Wilcoxon  $p= 0,674$ ). When analysing all ten subjects AV1  $17,6 \pm 9,9$ , AV2  $18,4 \pm 10,0$  and AV3  $13,9 \pm 6,0$ ; observing increase of 0,8 score in spot counts between AV1 and AV2 and sequent decrease of 3,7 score AV1 compared to AV3,

however not significant initial stage (Wilcoxon Mann Whitney  $p=0,671$ ) and final stage (Wilcoxon Mann Whitney  $p=0,674$ ), data expressed in table 2.

Subject	Group 1		Group 2	
	AVI	AVF	AVI	AVF
1	34	25	17	13
2	8	8	17	15
3	16	10	18	14
4	8	6	13	19
5	9	9	36	20
Mean	15	11,6	20,2	16,2
Standard Deviation	11,14	7,64	9,04	3,11
Median	9	9	17	15
Minimum	8	6	13	13
Maximun	34	25	36	20

Table 2: Inflammatory Spot Counts groups 1 e 2 Initial (AVI) and Final (AVF) Evaluation.

As for the Spot Counts, all ten subjects were classified as worse 10% ( $n=1$ ), unchanged 20% ( $n=2$ ), mild improvement 60% ( $n=6$ ), moderated improvement 10% ( $n=1$ ). Analysing following the groups division, 60% ( $n=3$ ) presented mild improvement for both groups, among the groups, group 2 stands out, obtained 20% ( $n=2$ ) of moderated improvement meanwhile 20% ( $n=1$ ) worsened. In group 1 40% ( $n=2$ ) was unchanged, expressed in graphic 3.



Stands out in figure 1, subject 1 of group 1, A. Initial Evaluation, B. Final Evaluation, noticing visible global decrease of spot counts and decrease of redness in lesions spots suggesting lower levels of inflammatory state. In figure 2, subject 3 of group 2, Initial Evaluation, B. Final

Evaluation, also noticing an apparent global decrease of spot counts and inflammatory state.



Figure 1: Subject 1, Group 1 (blue LED). A. initial evaluation B. final evaluation.

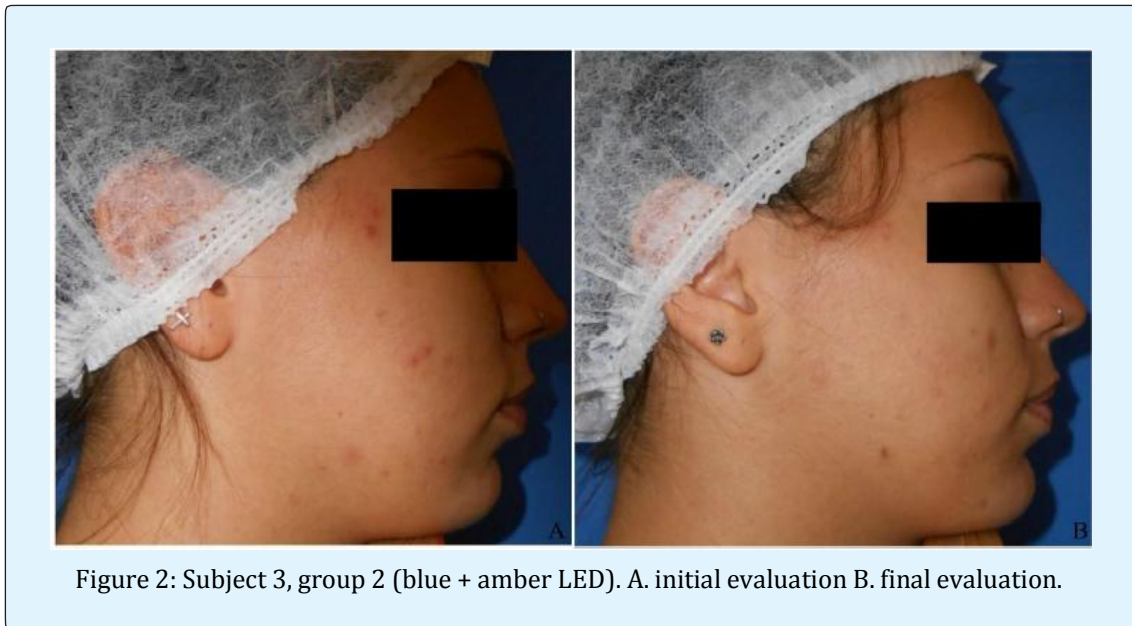


Figure 2: Subject 3, group 2 (blue + amber LED). A. initial evaluation B. final evaluation.

## Discussion

Coincidentally the gender of the subjects in the research was equated, counting with 50% male and 50% female, different of the observed in studies of Bertanha, et al. that when evaluating dermatologic profile of 16.399 subjects, 63,2% (n= 10.364) were women, possibly for their profile to look forward to health care [16]. However, the studies of Lauer mann, et al. when evaluating 2.201 men of 18 years old noticed 89,4% prevalence of acne in that population [17].

In experimental and quantitative study, Herrera, et al. 19 individuals were treated with blue LED, 2 sessions of 15 minutes per week, for 8 weeks total, obtaining significantly decrease of the mean number of spot counts (initial 45,1 final 16,4) expressive in grade II of acne, followed by grade III, preferentially in lower photo types (photo type II); also observed an improvement as the present study, comprising that the grades of acne tend to regress [18].



Epidemiological study from Bertanha, et al. accomplished in the city of São Paulo – Brazil, among the 16.399 subjects, 433 presented acne, being the more common dermatologic disease in children and adults of 11 to 35 years old. Either way that was observed in the present study, where the minor age was 19 years old and the major age was 24 years old [16].

Although the incidence of acne in higher photo types is large, the present study count with only one patient of IV photo type, when looking its results, noticing worse results indicating different answer of the treatment in higher photo types, can be justify for its tendency to oily skin since it possess bigger sebaceous glands and consequently has a higher production of sebaceous secretion when compared to lower photo types Alchorne, et al [19].

Number of sessions (6 sessions) used in the present research was inferior to the number brought by literature, Meffert, et al. get improvement in acne and seborrhea in men after 17 sessions of blue LED with 22KJ/cm<sup>2</sup> dose; posteriorly in 1990, Meffert, et al. noticed improvement of acne, seborrhea and quantity of porfirines inside the skin after 10 sessions, using 325 J/cm<sup>2</sup> dose, using a bulb of blue lamp of high pressure [20].

Kawada et al, when using blue light in clinical trial with 30 individuals, referred a decrease of 64% of lesion spots and a decrease for the quantity of P [21]. Acnes bacteria in vitro, with treatment frequency of 2 times per week for a total of 5 weeks, with a fluency of 90mW/cm<sup>2</sup> and 324J/cm<sup>2</sup> dose. In this research the author correlates the use of blue light with its capacity to reduce the quantity of bacteria growing in culture, observing its effectiveness and tolerance between the individuals with acne, suggesting photo therapy as a new modality of treatment for acne.

Arruda et al, when comparing the use of blue light to topic benzoil peroxide 5% in individuals with grade II and III of acne, by a prospective study, open, randomized and comparative, with 60 individuals, being GL (blue light group, n=30) with frequency of treatment of 2 sessions per week with a break of 48 hours, during 4 weeks, total of 8 sessions of 15 minutes each and 40mW/cm<sup>2</sup> dose and GP (benzoil peroxide group, n=30) with frequency of treatment of 2 times per day, during 4 weeks total of 8 sessions of 15 minutes each [22]. In this study the use of photo therapy it's compared to use of a topic drug, obtaining decrease of 31,32% of inflammatory and non inflammatory lesions using benzoil peroxide and reducing 21,66% of lesions, mean reduction of lesions similar

between groups, obtaining as outcome the effectiveness of both therapies, photo therapy with less adverse effects.

The present study counts with 10 subjects, however in literature are found several studies with different sample size, observing that most of the articles that used an abundant sample size, obtained good results passively for the size and homogeneity of subjects.

The second light that appears in literature it's red, known for its anti-inflammatory effects, although the majority of studies bring experimental groups with combination of two lights (blue and red) basing the present hypothesis of research of the present study that by the combination of two different lights, with distinct effects and depths reached would have a enhanced effect in treatment of acne.

Different from the larger part of studies, Na et al. when performing a clinical trial, randomized, controlled and blind, with 28 subjects, using only red LED in one hemi face as experiment and other as control group, treatment frequency of 2 times per day, during 8 weeks, 15 minutes each session, total of 112 sessions, with 604,8J/cm<sup>2</sup> final cumulative dose [23]. The experiment group obtained a reduction of 55% of lesions number compared to control (19%) in eighth week. It can be concluded the effectiveness of red light in acne management, suggesting that maybe the number of expositions has higher relevance that dose delivered to obtain positive results.

Araújo et al. studied the effect of lights, among them the amber light (590 to 630nm) in wound healing in n=25 wistar rats; experimental study, controlled and randomized, treatment in a daily frequency, 5 sessions followed, during 6 minutes 3w power [24]. As results the use of lights were effective in wound healing by second intention, the amber light stands out in obtaining the best epithelisation of wounds margin, its cicatrisation started with higher quality, higher concentration of collagen of superior quality and presenting the second best result in reduction of edema. Based on the findings of Araújo et al., the group that received the amber light in the present study may have had a better result for the effects of light in cicatricial process, working in a supporting way with blue light in resolution of inflammatory process [24].

The present study, reached to observe if the effects found in literature about amber light could complete the effects produced by blue light, formulating a new therapeutic approach with more effectiveness for treatment of acne.

It is believed that the idea of utilization of active substances with light in the clinical practice of dermatofunctional physiotherapists maybe from photo dynamic therapy, where are used photosensitizing actives as acid 5-aminolevulinic that gets photo activated by the light, being able to destroy specific tissues, well established in literature as observed in Torezan et al.; Issa et al. e Barbaric et al [25-27]. In clinical practice its common to use active substances combined with LEDs objecting to treat diverse aesthetic dysfunctions, however wasn't found studies that explain the mechanisms of interaction of the light to active substances on the skin proving its efficacy and superiority.

Acne is a disease that can psychological affect the individuals in general, what motivates the professionals to search for treatments that are resolute as in the disease as in the improvement of life quality and personal satisfaction with your image. A Diversity of studies brought as evaluation method the Analogical Visual Scale (AVS), in order to quantify in a subjective and qualitative way the grade of personal satisfaction with your skin along the treatment. Na et al. obtained significant decrease (3,9 to 1,8), using an adapted AVS (0 to 5, 0 null and 5 very severe) compared to control group, in 28 individuals treated with red LED [23]. In the present study the researchers opt for using the Facial Perception Visual Scale (FPVS) for subjective analysis of the subjects of research, obtaining clear tendency to improvement even though with not significant statistic.

Massuia, et al. verified the qualitative response of 9 individuals, male gender, to skin cleansing isolated, associated with 3 different products (Green Banana Peel Mask; Placebo of Green Banana Peel Mask; Acid) and controlled, in treatment of acne vulgaris, clinical trial, prospective and randomized. Using the FPVS as evaluation method and obtaining as result improvement of perception of the individuals as open and closed comedones, pain during the extraction, acne lesions, skin aspect and quality of life [15]. Also made use of CADI (The Cardiff Acne Disability Index) in order to evaluate the psychosocial impact of acne, observing between groups a diverse improvement of 21,43 to 100%.

The variation of data obtained as using the FPVS as CADI its due to grade of impact that acne has over the life of individuals, according to how each human being individually cares to acne in your daily life and in your life activities approached within the questionnaire evaluated by CADI and satisfaction presented by the individuals to their faces evaluated by FPVS. As well as seen in the populational study of Tasoula, et al. using 1531 teenagers

of 11 to 19 years old, observing that the grade of acne is directly proportional to the grade of the impact in quality of life, the same way, as higher the severity of acne more this population tends to modify its corporal image; moderate and severe grades of acne tend to present higher emotional and psychosocial worsening; the symptomatology and its treatments for acne directly influence the quality of life of individuals and acne affects equally men and women [28].

The predominant clinical manifestation of acne are inflammatory lesions, in order to quantify the number of lesions, the researchers performed the lesion spot counts as an evaluation mean, being able to contribute to assign the improvement by the decrease of lesions spot counts. The clinical trial, randomized and blind of Papageorgiou, et al., the lesion spot counts was applied to 107 patients submitted to 4 different treatments (blue LED, blue and red LED, benzoi peroxide 5% and white light) daily for 12 weeks, obtaining a mild improvement of 95% of inflammatory lesions between the blue and red light with the other treatments [13]. Kawada et al also performed the lesion spot counts obtaining 64% of improvement [21].

The lesion spot counts is an effective and trustworthy method for the researchers, however some items may interfere in spot counts as the presence of beard or even distract the evaluator as in case of folliculitis, obtaining variable results and much often questionable. One technical form to evaluate the differences between interventions, is the use of software that evaluate the changes found in skin face, as used by Estrela et al to evaluate de decrease of angle and nasogenian sulcus in 24 individuals submitted to red LED for tissue flaccidity [29,30].

In future studies suggests the use of a higher week frequency of treatment, seen that all studies analysed performed the daily application of LED, with monthly frequency higher than 4 weeks of duration, obtaining significant results; resistance found in the present study due to subjects availability to appear for the treatment with higher weekly and monthly frequency.

By observing the analysis of psychosocial by means of CADI and FPVS, the patients didn't present expressive improvement, possibly since the impact depends of how each individual cares about acne, being heterogenic data among the subjects. In the present research, stands out the subject of number 5, group 2 that presented acne and didn't refer complaints about its psychosocial as observed

by CADI and FPVS, even though the researchers observed the improvement by the lesions spot counts.

As mentioned, the lesions spot counts can present certain grade of subjectivity, depending of the evaluator to find the lesions and differentiate acne of other manifestations, being necessary to refine the method of evaluation as performed in the present study, subdividing the face into areas (forehead, right hemi face and left hemi face) or using software of image to precisely evaluate.

By observing the results obtained in both groups, notice improvement for both interventions (blue versus blue/amber), however without presenting significant difference, possibly for the heterogeneity of the subjects, sample size and above all for the insufficient exposure time to observe differences. It is suggested for future studies improvement in these aspects as the inclusion of an amber group to evaluate its isolated efficacy in acne treatment.

## Conclusions

The treatment through LED to improvement of acne lesions showed up effective as by the use of blue light as by the use of blue light combined with amber light, obtaining qualitative results reducing the scores of CADI and FPVS and quantitative results reducing the number of lesions by LSC. Showing itself to be an effective therapeutic, secure and with good results in treatment of acne, needing future studies with larger number of subjects, variability of treatment groups, increase of the number of sessions and week frequency of treatment, allowing the data analysis with greater reliability to define its isolated effect and its associated ones.

## References

1. Vivier AD, Mckee PH (1997) Doenças das Glândulas Sebáceas, Sudoríparas e Apócrinas. In: Atlas de Dermatologia Clínica. São Paulo: Editora Manole pp: 1-10.
2. Wolff K, Johnson RA, Saavedra AP (2015) Distúrbios das Glândulas Sebáceas e Apócrinas. In: Dermatologia de Fitzpatrick: Atlas e Texto. New York: AMGH Editora Ltda pp: 2-7.
3. Costa CS, Bagatin E (2013) Evidências sobre o tratamento da acne. *Diagn Tratamento* 18(1): 10-14.
4. Hadade CSG, Rolino DF, Oliveira MMC, Nadal M, Braga T (2009) Distúrbios das secreções sebácea, écrina e apócrina. In: Petri V. *Dermatologia Prática*. Rio de Janeiro: Guanabara Koogan pp: 35-44.
5. Barolet D (2008) Light-Emitting Diodes (LEDs) in Dermatology. *Semin Cutan Med Surg* 27(4): 227-238.
6. Holmes HS (2014) Acne, rosácea e distúrbios relacionados. In: Soutor C, Hordinsky M. *Dermatologia Clínica (Lange)*. Porto Alegre: AMGH pp: 138-144.
7. Meyer PF, Araújo HG, Carvalho MGF, Tatum BIS, Fernandes ICAG, et al. (2010) Avaliação dos efeitos do LED na cicatrização de feridas cutâneas em ratos Wistar. *Fisioterapia Brasil* 11(6): 428-432.
8. Lee WS, Shalita AR, Poh-Fitzpatrick MB (1978) Comparative Studies of Porphyrin Production in *Propionibacterium acnes* and *Propionibacterium granulosum*. *Journal of Bacteriology* 133(2): 811-815.
9. Ashkenazi H, Malik Z, Harth Y, Nitzan Y (2003) Eradication of *Propionibacterium acnes* by its endogenous porphyrins after illumination with high intensity blue light. *FEMS Immunol Med Microbiol* 35(1): 17-24.
10. Filgueira AL, Duque HE, Azulay RD (2013) Tratamento pelas radiações. In: Azulay RD, Azulay DR, Azulay-Abulafia L. *Dermatologia-Sexta edição revisada e atualizada*. Rio de Janeiro: Guanabara Koogan pp: 691-697.
11. Elman M, Lask G (2004) The role of pulsed light and heat energy (LHE) in acne clearance. *J Cosmet Laser Ther* 6(2): 91-95.
12. Leyden JJ, Hickman JG, Jarratt MT, Stewart DM, Levy SF (2001) The Efficacy and Safety of a Combination Benzoyl Peroxide/Clindamycin Topical Gel Compared with Benzoyl Peroxide Alone and a Benzoyl Peroxide/Erythromycin Combination Product. *Journal Cutan Med Surg* 5(1): 37-42.
13. Papageorgiou P, Katsambas A, Chu A (2000) Phototherapy with blue (415 nm) and red (660 nm) light in the treatment of acne vulgaris. *British Journal of Dermatology* 142(5): 973-978.
14. Grando RL, Cunha TV, Horn R, Cestari T (2016) Translation, cultural adaptation and validation for Brazilian Portuguese of the Cardiff Acne Disability Index instrument. *Na Bras Dermatol* 91(2): 180-186.



15. Massuia FAO, Silva DF, Santos FMR, Durante RF, Trofino MR, et al. (2011) Intervenção Fisioterapêutica em Comedões Abertos e Fechados na Acne Vulgar. *Revista Inspirar* 3(1): 31-40.
16. Bertanha F, Freiberg AK, Neto CF, Nelumba EJP, Samorano LP (2016) Profile of patients admitted to a triage dermatology clinic at a tertiary hospital in São Paulo, Brazil. *An Bras Dermatol* 91(3): 318-325.
17. Lauermaann FT, Duquia RP, Breunig JA, Junior HLA, Souza PRM (2016) Acne scars in 18-year-old male adolescents: a population-based study of prevalence and associated factors. *An Bras Dermatol* 91(3): 291-295.
18. Herrera SDSC, Mota JR, Chaves SP, Ueda TK, Rezende AAB (2012) Congresso Brasileiro de Fisioterapia Dermato Funcional, 2012 Nov 1-6; Recife, Pernambuco. Brasil.to da acne vulgar. Congresso Brasileiro de Fisioterapia Dermato Funcional pp: 1-5.
19. Alchorne MMA, Abreu MAMM (2008) Dermatologia na pele negra. *An Bras Dermatol* 83(1): 7-20.
20. Meffert h, Scherf HS, Sonnichsen N (1987) Treatment of acne vulgaris with visible light. *Dermatol Monastsschr* 173(11): 678-679.
21. Apud Paschoal FM, Ismael APPB (2010) A ação da luz no tratamento da acne vulgar. *Surg Cosmet Dermatol* 2(2): 117-123.
22. Kawada A, Agarane Y, Kameyama H, Sangen Y, Tezuka T (2002) Acne phototherapy with a high-intensity, enhanced, narrowband, blue light source: an open study and in vitro investigation. *Journal of Dermatological Science* 30(2): 129-135.
23. Arruda LHF, Filho AB, Kodani V, Mazzaro CB (2009) Estudo clínico, prospectivo, aberto, randomizado e comparativo para avaliar a segurança e a eficácia da luz azul versus peróxido de benzoíla 5% no tratamento da acne inflamatória graus II e III. *An Bras Dermatol* 84(5): 463-468.
24. Na JI, Suh DH (2007) Red Light Phototherapy Alone Is Effective for Acne Vulgaris: Randomized, Single-Blinded Clinical Trial. *Dermatol Surg* 33(10): 1228-1233.
25. Araujo HG, Silva RMV, Canela PM, Silva NF, Santos-Filho FC, et al. (2015) Different Wavelengths of LEDs on Cutaneous Wound Healing in Wistar Rats. *Journal of Basic & Applied Sciences* 11: 389-396.
26. Torezan L, Neto CF, Niwa ANM (2009) Terapia fotodinâmica em dermatologia: princípios básicos e aplicações. *An Bras Dermatol* 84(5): 445-459.
27. Issa MCA, Manela-Azulay M (2010) Terapia fotodinâmica: revisão da literatura e documentação iconográfica. *An Bras Dermatol* 85(4): 501-511.
28. Barbaric J, Abott R, Posadzki P, Car M, Gunn LH, et al. (2016) Light therapies for acne. *Cochrane Database of Systematic Reviews* 9: CD007917.
29. Tasoula E, Gregoriou S, Chalikias J, Lazarou D, Danopoulou I, et al. (2012) The impact of acne vulgaris on quality of life and psychic health in young adolescents in Greece. *An Bras Dermatol* 87(6): 862-869.
30. Estrela JV, Duarte CCF, Almeida DNA, Araruna VR, Silva RMV, et al. (2014) Efeito do led na flacidez tissular facial. *Revista Científica da Escola da Saúde UP* 3(2): 29-36.