

## Efficacy of Pulsed Dye Laser on Acne Vulgaris

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**Abstract:** Acne is one of the most common skin diseases affecting majority of the teens and reaching its pinnacle during adulthood it can persist for years; produce disfigurement and permanent scarring; and have significant psychosocial consequences, including diminished self-esteem, embarrassment, social withdrawal, depression, and unemployment. Pulsed dye laser decreases post-inflammatory erythema left by acne, reducing colonization of the bacterium and ultimately the number of active inflammatory acne lesions. **Purpose:** The current study was carried out to evaluate the efficacy of pulsed dye laser (PDL) in the treatment of acne vulgaris. **Methods:** - Forty patients with acne vulgaris were randomly divided into two equal groups (PDL group and control group). The methods of assessment included investigator's global assessment (IGA) and photographic method. For PDL Group, they received 3 sessions of PDL therapy with 4 weeks interval plus topical antibiotic medication while the control group received only topical antibiotic medication. **Results:** - The results showed that there was significant decrease in acne counts ( $p < 0.001$ ) in PDL group compared with the control group. In relation to IGA and photographic method, the study revealed that the results obtained in study group were superior to that of control group. **Conclusion:** - It was concluded that pulsed dye laser PDL was effective in controlling of acne vulgaris lesion in expression of decreasing numbers of acne lesions and improving the appearance.

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**Key Words:** Acne Vulgaris, Pulsed Dye Laser (PDL), Investigator's Global Assessment (IGA)

### 1. Introduction

Acne vulgaris is a disease of the pilosebaceous follicle characterized by non-inflammatory (open and closed comedones) and inflammatory lesions (papules, pustules, and nodules). Its pathogenesis is multifactorial - the interplay of hormonal, bacterial, and immunological (inflammatory) factors results in the formation of acne lesions. Although acne is not a life-threatening condition, it can have detrimental effects on the quality of life of affected individuals [1].

The pathogenesis of acne vulgaris is multifactorial. The key factor is genetics. [2], Acne develops as a result of an interplay of the following 4 factors: Follicular epidermal hyperproliferation with subsequent plugging of the follicle. Excess sebum production, The presence and activity of the commensal bacteria *Propionibacterium acnes*, Inflammation [3].

Acne vulgaris is one of the most common skin conditions and can result in scarring and disfigurement. Oral retinoids, oral antibiotics, topical retinoids, topical antibiotics, and keratolytics are commonly used to treat acne, but such treatment options have many well-known risks, complications, and limitation. [4]

Recently, several laser and light-based therapies (radiofrequency, [5] Photodynamic therapy, [6-9] and visible light [10, 11] using various wavelengths have

been evaluated for the treatment of acne vulgaris. [12] The pulsed dye laser (PDL) [13-15] is one such promising treatment option. PDL produces light of 585- and 595-nm wavelengths, which mainly oxyhemoglobin absorbs, and is mainly used to treat vascular lesions, such as port-wine stains, but PDL has also been reported to be effective at treating inflammatory acne vulgaris. [4]

### 2. Material and Methods:

In this study, 40 patients with acne vulgaris were assigned randomly into two groups (study and control groups) of equal number. **Group (A):** The study group received 3 sessions of PDL therapy with 4 weeks interval plus traditional topical antibiotic medication, **Group (B):** The controlled group received only traditional topical antibiotic medication.

### Inclusive Criteria included

Patient ages ranged from 18 to 25 years in both sexes with acne vulgaris in one or more of the following areas: face, back and upper arms, they were non smoker, not alcohol drinker and had no systemic diseases, all patients with skin type III and IV depending on scale stated by Wolff *et al.*, [16] Patients with mild to moderate acne vulgaris according to scale stated by Burton *et al.*, [17]

### Exclusive Criteria included

Patients who had skin malignancy, history of diabetes, circulatory or sensory disorders, mental or psychological disorders and any systemic diseases specially that might interfere with objectives of the study as pulmonary, cardiac or vascular diseases. Patients who received radiotherapy, chemotherapy or photosensitive drugs. Patients who had photosensitivity or have a history of frequent sunburns and Patients with any dermatological condition rather than acne vulgaris.

### Ethics

The protocol of this study approved by the ethical committees of the faculty of physical therapy (Cairo University, Egypt). Every patient applied informed consent before starting the study. All participants were informed about the nature and the effect of the treatment and measurement devices. The patients were also instructed to report any side effects during the treatment sessions.

## 2. Measurements

### 1- Digital camera:

Sony cyber shot digital still camera, 3.2 mega pixels, model NO.DSC-P72, Sony lens/optical 3x, F=6-18 mm 1:2.8-5.6. It is made in Japan; the camera was applied vertical to the affected area. The light of the room was good enough to obtain clear photo, the distance between the patient and camera, the illumination and the magnification were fixed for every patient. Photographic picture were taken to every patient at the base line, and at 12<sup>th</sup> week after the first treatment.

### 2- The investigator's global assessment (IGA):

The IGA is a qualitative assessment used to determine the degree of improvement. It's a scale with approximately six severity grades, it is graded from (worse to clearance), the scale was explained for every patient, the IGA was taken to every patient at the base line, 4, 8 and 12<sup>th</sup> week after the first treatment, the comparison was done each time to the initial acnes count.

### Treatment procedures:

**Group A (Experimental, PDL group).** The patient was placed in suitable position and was asked to take off the clothes in the treated area only, the patient was asked not to look to the PDL rays and special safety glasses was worn by both patient and therapist during the treatment, PDL probe was in perpendicular direction to the treated area. The patient was instructed to report any side effects during or after the treatment sessions. The patient was received 3 sessions of PDL with 4 weeks interval at 595nm, pulse duration 350 msec and hand piece of

spot size 5 or 7mm. The energy density employed at 4 J/cm<sup>2</sup>. The treatment session lasted about 2 or three minutes. The patient was followed up at 4, 8, 12<sup>th</sup> weeks after the first treatment. **Group B (control group):** Patients in the control group received only traditional topical antibiotic medication.

### Statistical procedures:

Data of the study recorded as the means  $\pm$ SD. The data analyzed by using SPSS 18 (SPSS Inc.USA). Compare between both groups of the study Performed by (ANOVA).

## 3. Results

All the patients involved in the study have been continued the study until the end of it. None refused or withdrawn. The study group consisted of 20 patients (8 males and 12 females). Their ages ranged from 18-25 years with a mean value of 21.3 $\pm$ 2.0, their acnes number ranged from 36-16 acnes with a mean value of 25.7 $\pm$ 5.88. The control group consisted of 20 patients (9 males and 11 females). Their ages ranged from 18-25 years with a mean value of 21.05 $\pm$ 2.18, while the acnes counts ranged from 38-16 acnes with a mean value of 25.75 $\pm$ 6.71. There was no significant difference between both groups in the mean value of patients' ages and acnes counts.

Both group means and SDs for Acnes count Pre treatment, Post1 (at 4<sup>th</sup> week), Post2 (at 8<sup>th</sup> week), and Post 3 (at 12<sup>th</sup> week) are shown in table (1) and graphically presented in Fig (1).

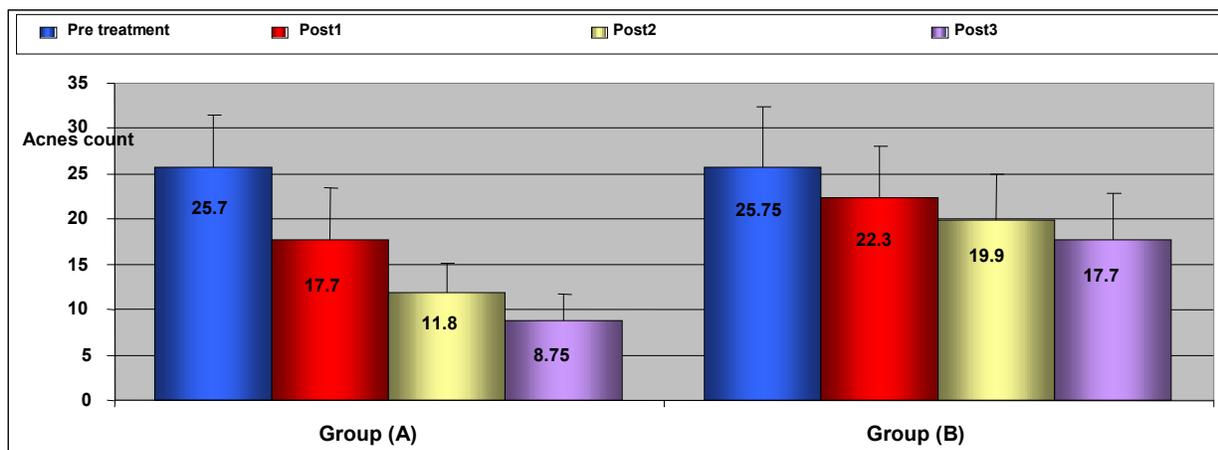
For Group (A) the mean of Acnes count Pre treatment was (25.7 $\pm$ 5.88). The Acnes count Post1 (at 4<sup>th</sup> week) was (17.7 $\pm$ 5.83), the Acnes count Post2 (at 8<sup>th</sup> week) was (11.8 $\pm$ 3.3), and finally the Acnes count Post3 (at 12<sup>th</sup> week) was (8.75 $\pm$ 2.91). For Group (B) the mean of Acnes count Pre treatment was (25.75 $\pm$ 6.71). The Acnes count Post1 (at 4<sup>th</sup> week) was (22.3 $\pm$ 5.75), the Acnes count Post2 (at 8<sup>th</sup> week) was (19.9 $\pm$ 5.19), and finally the Acnes count Post3 (at 12<sup>th</sup> week) was (17.7 $\pm$ 5.14).

For Group (A) there was a significant difference of Acnes count values between Pre treatment value and Post1 value as t-value was (12.07) and p-value was ( $P < 0.001$ ), Pre treatment value and Post2 value as t-value was (20.98) and  $P$ -value was ( $P < 0.001$ ), and between Pre treatment value and Post3 value as t-value was (25.58) and  $P$ -value was ( $P < 0.001$ ). Also there was a significant difference of Acnes count values between Post1 value and Post2 value as t-value was (8.9) and  $P$ -value was ( $P < 0.001$ ), Post1 value and Post3 value as t-value was (13.51) and p-value was ( $P < 0.001$ ), and finally between Post2 value and Post3 value as t-value was (4.6) and  $P$ -value was ( $P < 0.001$ ) as shown in table (2).

**Table (1): Mean and SD of Acnes count Pre treatment, Post1, Post2, and Post3 for groups (A,B).**

Acnes count	Group (A)					Group (B)				
	Mean	±SD	Max.	Min.	Range	Mean	±SD	Max.	Min.	Range
Pre treatment	25.7	±5.88	36	16	20	25.75	±6.71	38	16	22
Post1 (at 4 <sup>th</sup> week)	17.7	±5.83	28	10	18	22.3	±5.75	32	14	18
Post2 (at 8 <sup>th</sup> week)	11.8	±3.3	18	7	11	19.9	±5.19	29	12	17
Post3 (at 12 <sup>th</sup> week)	8.75	±2.91	14	5	9	17.7	±5.14	27	10	17

\*SD= standard deviation

**Fig (1): Mean and ±SD of Acnes count Pre treatment, Post1, Post2, and Post3 for group (A, B).****Table (2): post hoc test of the Acnes count Pre treatment, Post1, Post2 and Post3 for Group (A).**

Comparison	Mean Difference	% of improvement	t-value	P-value	S
Pre treatment vs. Post1 (at 4 <sup>th</sup> week)	8.0	31.12%	12.07	<0.001	S
Pre treatment vs. Post2 (at 8 <sup>th</sup> week)	13.9	54.08%	20.98	<0.001	S
Pre treatment vs. Post3 (at 12 <sup>th</sup> week)	16.95	65.95%	25.58	<0.001	S
Post1 (at 4 <sup>th</sup> week) vs. Post2 (at 8 <sup>th</sup> week)	5.9	33.33%	8.9	<0.001	S
Post1 (at 4 <sup>th</sup> week) vs. Post3 (at 12 <sup>th</sup> week)	8.95	50.56%	13.51	<0.001	S
Post2 (at 8 <sup>th</sup> week) vs. Post3 (at 12 <sup>th</sup> week)	3.05	25.84%	4.6	<0.001	S

For Group (B) there was a significant difference of Acnes count values between Pre treatment value and Post1 value as t-value was (9.3) and p-value was ( $P < 0.001$ ), Pre treatment value and Post2 value as t-value was (15.78) and  $P$ -value was ( $P < 0.001$ ), and between Pre treatment value and Post3 (after 3 months) value as t-value was (21.71) and p-value was ( $P < 0.001$ ), there was a significant difference of

Acnes count values between Post1 value and Post2 value as t-value was (6.47) and  $P$ -value was ( $P < 0.001$ ), between Post1 value and Post3 value as t-value was (12.41) and  $P$ -value was ( $P < 0.001$ ), and finally between Post2 value and Post3 value as t-value was (5.93) and  $P$ -value was ( $P < 0.001$ ) as shown in table (3).

**Table (3): post hoc test of the Acnes count Pre treatment, Post2, and Post3 for Group (B).**

Comparison	Mean Difference	% of improvement	t-value	P-value	S
Pre treatment vs. Post1 (at 4 <sup>th</sup> week)	3.45	13.39%	9.3	$P < 0.001$	S
Pre treatment vs. Post2 (at 8 <sup>th</sup> week)	5.85	22.71%	15.78	$P < 0.001$	S
Pre treatment vs. Post3 (at 12 <sup>th</sup> week)	8.05	31.26%	21.71	$P < 0.001$	S
Post1 (at 4 <sup>th</sup> week) vs. Post2 (at 8 <sup>th</sup> week)	2.4	10.76%	6.47	$P < 0.001$	S
Post1 (at 4 <sup>th</sup> week) vs. Post3 (at 12 <sup>th</sup> week)	4.6	20.62%	12.41	$P < 0.001$	S
Post2 (at 8 <sup>th</sup> week) vs. Post3 (at 12 <sup>th</sup> week)	2.2	11.05%	5.93	$P < 0.001$	S

Between groups: The independent t-test was performed to determine the difference in Acnes count at Pre treatment and Post1, and Post2, and

Post3 between Groups (A,B). There was no significant difference between both groups in Acnes count at Pre treatment values where the t-value was

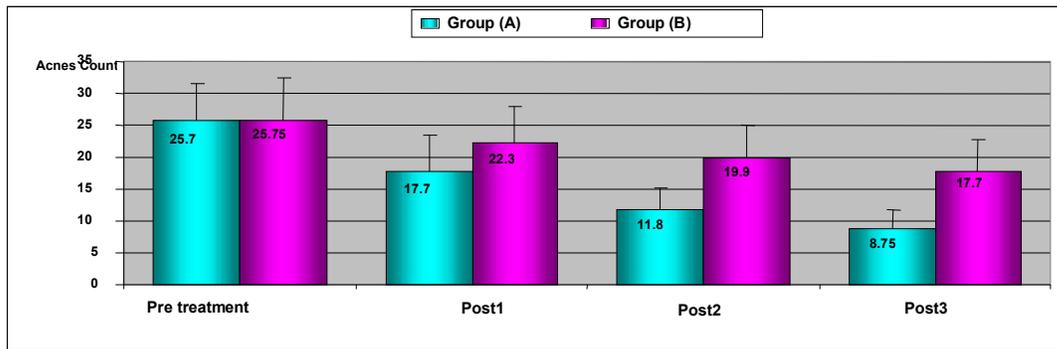
(0.02) and  $p$ -value was (0.98). While there was a significant difference between both groups in Acnes count at Post1 values where the  $t$ -value was (2.51) and  $p$ -value was (0.01), there was a significant difference between both groups in Acnes count at Post2 values where the  $t$ -value was (5.88) and  $p$ -

value was (0.0001), and finally there was a significant difference between both groups in Acnes count Post3 values where the  $t$ -value was (6.77) and  $p$ -value was (0.0001) as shown in table (4), Fig (2).

**Table (4): Independent t-test for Acnes count at Pre treatment, Post1, Post2, and Post3 between Groups (A, B).**

Acnes count	Pre treatment	Post1	Post2	Post3
Mean difference	0.05	4.6	8.1	8.95
$t$ -value	0.02	2.51	5.88	6.77
$P$ -value	0.98	0.01	0.0001	0.0001
S	NS	S	S	S

\*SD: standard deviation, P: probability, S: significance, NS: non significant, S: significant.



**Fig (2): Mean and  $\pm$ SD of Acnes count at Pre treatment, Post1, Post2, and Post3 between Groups (A, B).**

By the end of the treatment according to (IGA) there were 19 patients (95 % of the patients) showed marked improvement while only 1 patient (5% of the patients) showed moderate improvement in Group(A) , while in Group(B) there were 19 patients (95 % of

the patients) showed mild improvement and only 1 patient (5% of the patients) showed moderate improvement.



**Fig.(3): patient with acne vulgaris before the treatment by PDL.**



**Fig.(4): patient with acne vulgaris after the treatment by PDL.**

#### 4. Discussion:

Acne is one of the most common skin diseases affecting majority of the teens and reaching its pinnacle during adulthood. In certain severe cases, it mounts to pronounced skin deformity. This appears to adversely dampen the self esteem of the affected which can eventually lead to depression and even suicides. The disease invariably diminishes in twenties but in some cases, it might even persist in thirties, forties and beyond and there is no such definite way to predict its spell. Majority of females suffer from mild to moderate acne at some stage of life. Although the pathogenesis still stands unknown, but some of the probable reasons could be: increased sebum production, ductal keratinization, bacterial colonization of the pilosebaceous ducts and inflammation [18]

The pulsed-dye laser emits visible light that is absorbed primarily by oxyhemoglobin and decreases post-inflammatory erythema left by acne. *P. acnes* produces endogenous porphyrins that absorb specific wavelengths of visible light and cause lethal oxidative damage to the bacterium thus, reducing colonization of the bacterium and ultimately the number of active inflammatory acne lesions [14,19]. This laser source seems not only to eliminate bacteria directly but also through stimulation of the immune system. On the other hand, the low fluence also induces the production of procollagen secondary to heating of the perivascular dermis, a process that may help reduce scarring associated with acne [20,21]

The most recent studies of the molecular mechanisms implicated in treating acne with laser light have reported an increase in the levels of transforming growth factor  $\beta$ 1 (TGF- $\beta$ 1) 24 hours after application of pulsed dye laser light at 585 nm, TGF- $\beta$ 1 is known to be a potent inducer of collagen synthesis and plays a central role in initiating wound healing. It is also an essential immunosuppressive cytokine that promotes the termination of inflammatory processes. In addition, it is the most potent known inhibitor of keratinocyte proliferation. [15]

So this controlled randomized study was conducted to determine the effect of pulsed dye laser (PDL) in controlling acne lesions in patients suffering from acne vulgaris, the results of this study revealed that there was a significance difference in acne count between the study and control group, although there was no significant difference between the two group at the beginning of the study(pre-treatment). As The radiation source in this study demonstrated a marked effect on acne lesions as well as being well tolerated. The reduction of number of skin lesions was 31.12% at 4th week, 54.08% at 8th week and 65.95% at 12th week of PDL application while in the control group

the acne counts reported percentage of improvement of 13.39% at 4th week, 22.71% at 8th week and reached to 31.26% at 12th week of the drug application which prove the efficacy of pulsed dye laser in controlling the acne counts and improving the appearance.

The results of this study come in agree with **Choi et al.**, [22], **Jung et al.**, [4], **Leheta.**, [23], **Sami et al.**, [24], **Yoon et al.**, [25], **Harto et al.**, [26], **Seaton et al.**, [14]

**Choi et al.**, [22] compared between intense pulsed light (IPL) and pulsed dye laser (PDL) on facial acne. The study showed that numbers of total acne lesions decreased following both treatments. Histopathological examinations showed amelioration in inflammatory reactions and an increase in TGF- $\beta$  expression after both treatments, which were more prominent for PDL-treated sides.

**Jung et al.**, [4] compared the efficacy and safety of PDL and of combined 585/1,064-nm laser treatment for mild to moderate facial acne. At the final visit, inflammatory acne lesions were reduced by 86% on the PDL sides and by 89% on the 585/1,064-nm laser sides. Non-inflammatory acne lesions showed corresponding reductions of 69% and 64%, respectively. Histopathologic findings demonstrated reductions in inflammation for both treatments. The authors concluded that PDL and combined 585/1,064nm laser were safe and effective for the treatment of inflammatory and noninflammatory acne lesions.

**Leheta.**, [23] evaluated the role of the pulsed dye laser in the treatment of acne in comparison with other topical therapeutic the study included 45 patients with mild to moderate acne and were randomly divided into three groups: group A received treatment with pulsed dye laser therapy every 2 weeks, group B received topical preparations and group C was subjected to chemical peeling using trichloroacetic acid 25%. The study showed a significant improvement of the lesions within each group at 12 weeks of treatment with the best results seen in group A; however, no significant difference was detected between the three treatment protocols after the treatment period. Remission in the follow-up period was significantly higher in the first group. They concluded that Pulse dye laser therapy mainly improves the inflammatory lesions of acne with few adverse effects.

**Sami et al.**, [24] investigated the effectiveness of pulsed dye laser (PDL), intense pulsed light (IPL) and light-emitting diode (LED) phototherapy for the treatment of moderate to severe acne vulgaris. The study showed that patients treated with the PDL reached a  $>$  or  $=$  90% clearance of their inflammatory lesions after a mean of 4.1 +/- 1.39 sessions, while

patients treated with IPL required a mean of 6 +/- 2.05 sessions. Patients treated with the LED required a mean of 10 +/- 3.34 sessions. The encouraging results of the this study contributes evidence of phototherapy as useful therapeutic option for treatment of moderate to severe acne

**Yoon et al.**, [25] demonstrated the clinical efficacy and safety of a long pulse duration 595-nm PDL (V-beam laser H) therapy for the treatment of acne erythema. The study showed that a total of 90% of acne erythema patients achieved clinical improvement. Lesion counts decreased 24.9% after the first treatment (pv0.05) and by 57.6% (versus baseline) after the second treatment (pv0.05).

**Harto et al.**, [26] studied 36 patients with mild to moderate acne vulgaris. they performed treatment every 4 weeks using pulsed dye laser therapy with a wavelength of 585 nm and pulse duration of 350 Microseconds and at twelve weeks of treatment a decrease of 27% of non inflammatory lesions and of 57% of active lesions was observed. Treatment was well tolerated and considered positive, in terms of healing, in 25patients, they concluded that Pulsed dye laser therapy mainly improves inflammatory lesions of acne with few adverse effects.

**Seaton et al.**, [14] performed a study on 41 adults with mild-to-moderate facial inflammatory acne. Treatment was well tolerated. Total lesion counts fell by 53% (IQR 19 to 64) in PDL patients and 9% (-16 to 38) in controls ( $p=0.023$ ). and inflammatory lesion counts reduced by 49% (30 to 75) in PDL patients and 10% (-8 to 49) in controls ( $p=0.024$ ). The study showed that PDL therapy improves inflammatory facial acne 12 weeks after one treatment with no serious adverse effects.

### Conclusion

From the previous discussion of these results and according to reports of researches in the field related to the present study, it could be concluded that PDL is safe and effective method in controlling of acne vulgaris lesion in expression of decreasing numbers of acne lesions and improving the appearance.

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