



Assessment of Effectiveness of Intense Pulse Light Versus Fractional co₂ Laser in Treatment of Both Stages of Acne Vulgaris

Ahmed S. Kadah ^{a++*}, Marwa Said ^{b#}, Ahmed H. Nouh ^{c†}
and Maged Elsheikh ^d

^a Dermatology and Venereology, Al-Hussin University Hospital, Al-Azhar University, Egypt.

^b Dermatology and Venereology, Faculty of Medicine for Girls, Al-Azhar University (Cairo), Egypt.

^c Dermatology and Venereology, Faculty of Medicine, Al-Azhar University, Egypt.

^d Department of Dermatology and Venereology, Military Medical Academy, Egypt.

Authors' contributions

This work was carried out in collaboration among all authors. Author ASK designed the research study. Author MS analysed the data and wrote the paper. Author AHN contributed essential tools of the paper. Author ME designed the research study. All authors read and approved the final manuscript.

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ABSTRACT

Acne is an inflammatory and non-inflammatory disorder, associated with socialization and mental health problems that affects more than 80% of teenagers [1]. Acne is characterized by inflamed papules, and black and white comedons affecting the face, neck, back, and chest. In more severe cases cysts and scarring can also occur. Various treatment modalities have been introduced,

⁺⁺ Lecturer Fellow;

[#] Assistant Professor;

[†] Lecturer;

*Corresponding author: E-mail: dr.A.S.kadah@gmail.com;

however, Laser is still a more effective, convenient, and safer therapies, as other therapies have many adverse effects including poor efficacy, recurrence, high cost, irritation, bacterial resistance, and teratogenicity.

Aim: To study the treatment of different types of acne vulgaris by fractional laser and intense pulsed light (IPL) to assess the potential role of their curative effect

Methods: sixty patients with both stages (inflammatory and non-inflammatory acne) involving their face were divided into 2 groups: **Group -1:** 30 patients with inflammatory acne received split face treatment 530 nm intense pulsed light (IPL) in one side (**subgroup-A**) and fractional co2 on the other side (**subgroup-B**), **Group-2:** 30 patients with non-inflammatory acne received split face treatment 530 nm IPL in one side(**subgroup-C**) and fractional co2 on the other side(**subgroup-D**). Treatments once every 2 weeks. Assessments at baseline and after the fourth session by counting the lesions and usage of the global acne grading system.

Results: No statistically significant difference (p -value > 0.05) between studied groups as regard age and sex. No statistically significant difference (p -value > 0.05) between the studied groups as regard acne duration. As regards the pre-session acne score, there was: No statistically significant difference ($p_1 = 0.285$). After treatments, there was: Highly statistically significant difference ($p_3 < 0.001$) between subgroup- A & subgroup- B. As regards the 6th session acne score, there was: Highly statistically significant difference ($p_1 < 0.001$) between subgroup-C & subgroup-D. A highly statistically significant difference ($p_2 < 0.001$).

Conclusion: The highly significant improvement in inflammatory lesions among patients treated with IPL however, fractional co2 laser is considered a better therapeutic modality for non – inflammatory acne

Keywords: Fractional Co2 Laser; intense pulse light; acne Vulgaris.

1. INTRODUCTION

“Acne vulgaris is a disorder of sebaceous gland hyperactivity, altered keratinization of ductal keratinocytes and resultant follicular plugging, the overgrowth of propionibacterium acnes, and inflammatory signaling. Intense Pulsed Light (IPL) system is a treatment that can cause a clinical improvement in inflammatory acne through modification of TLR2 and TNF α expression” [2].

The fractional CO₂ laser is very beneficial in treating acne scars. However, it can be used in the treatment of active acne lesions as it also tends to treat enlarged oil glands (especially around the nose), Sun damage, uneven skin tone, and the hyperpigmentation associated with the condition. “Long pulse modes with low density and low fluence are preferred to prevent possible epidermal damage; multiple treatment sessions are needed to minimize complications and optimize results. fractional carbon dioxide laser decrease photodamage, recent tan, and pigment at the scar base, thus decreasing the possibility of post-inflammatory hyperpigmentation” [3].

2. METHODS

Sixty patients with inflammatory and non-inflammatory acne involving their face collected

from Al-Azhar University hospitals were divided into 2 groups:

Group-1: 30 patients with inflammatory acne received split face treatment 530 nm IPL (EMA Doubles II) on one side (**subgroup-A**): Parameters used were wavelength (cut off filter) – 550 nm to 1200 nm, spot size – 40 mm² × 8 mm², pulse duration – 5 ms (two pulses), pulse interval – 10 ms, and fluence 20-35 J/cm². The fluence was reduced by 20% on the forehead and bony prominences to avoid post-inflammatory hyperpigmentation and scarring, and fractional co₂ on the other side (**subgroup-B**), using CO₂ laser only. DEKA smart idea (Italy made 2015) (REF-MO79S1) (SNUX5) was used with parameters set as follows: power 13W, dwell time 800ms, spacing 600ms, and stack 1.

Group-2: 30 patients with non-inflammatory acne received split face treatment 530 nm IPL on one side(**subgroup-C**) Parameters used were wavelength (cut off filter) – 550 nm to 1200 nm, spot size – 40 mm² × 8 mm², pulse duration – 5 ms (two pulses), pulse interval – 10 ms, and fluence 20-35 J/cm². The fluence was reduced by 20% on the forehead and bony prominences to avoid post-inflammatory hyperpigmentation and scarring, and fractional co₂ on the other side (**subgroup-D**), using DEKA smart idea (Italy made 2015) (REF-MO79S1) (SNUX5) was used

with parameters set as follows: power 13W, dwell time 800ms, spacing 600ms, and stack 1. Treatments once every 2 weeks. Assessments at baseline and after the fourth treatment included lesion counts and the global acne grading system.

The global acne grading system [4]	
Location	Factor
Forehead	2
Right cheek	2
Left cheek	2
Nose	1
Chine	1
Chest and upper back	3

Note: Each type of lesion is given a value depending on severity; no lesions = 0, comedones = 1, papules = 3, and nodules = 4

The score for each area (Local score) is calculated using the formula: Local score = Factor × Grade (0-4). The global score is the sum of local scores, and acne severity was graded using the global score. A score of 1-18 is considered mild; 19-30, moderate, 31-38, severe; and > 39, very severe.

2.1 Post-Procedure Care

We instructed the patients to avoid the followings: washing the face for 24 hours following the procedure, application of topical antibiotic cream, and exposure to sunlight for at least 7 days after the procedure. The patients were also instructed to use sunscreens before sun exposure. Evaluation of possible side effects after each treatment session and at each follow-up. The rapid side effects such as erythema, burning sensation, edema, and pain, and possible late side effects such as hyper and hypopigmentation, milia, blister, and scarring. The appearance of new lesions during treatment was also noted on both sides of the face.

2.2 Statistical Analysis

An Excel spreadsheet was established for the entry of data. We used validation checks on numerical variables and an option-based data entry method for categorical variables to reduce potential errors. The analyses were carried out with SPSS software (Statistical Package for the Social Sciences, version 24, SSPS Inc, Chicago, IL, USA). Frequency tables with percentages were used for categorical variables and

descriptive statistics (median and interquartile range [IQR]) were used for numerical variables. Independent Student t-tests, paired t-tests, or Mann-Whitney tests were used to compare quantitative variables, while Chi-square test or McNemar-Bowker tests were used to analyze categorical variables. A p-value < 0.05 is considered statistically significant.

3. RESULTS

This study included 60 patients divided into two groups(I, II) each of them divided into 2 subgroups (A, B, and C, D) patients inserted in both groups, were treated with fractional Co2 in one-half of the face and received IPL at the second half of the face. Sessions were repeated every 2 weeks until complete clearance or a maximum period of 6 months. No statistically significant difference (p-value > 0.05) between the studied groups as regard age and sex (Table 1).

As regards 2nd session acne score, there was no statistically significant difference (p1 = 0.947) between group 1 & group 2(Table 2).

As regards the 4th session acne score, there was no statistically significant difference (p1 = 0.546) between group A & group B, a highly statistically significant difference (p2 < 0.001) between Subgroup A & subgroup C, a highly statistically significant difference (p3 < 0.001) between subgroup B &subgroup D(Table 3). However, as regards the 6th session acne score, there was a highly statistically significant difference (p1 < 0.001) between group A & group B, a highly statistically significant difference (p2 < 0.001) between subgroup A & group C, a highly statistically significant difference (p3 < 0.001) between subgroup B & group D(Table 4). A highly statistically significant difference was found (p1 < 0.001) between acne score follow-up (pre, 2nd, 4th & 6th session) in subgroup A (Table 5). Also, a highly statistically significant difference (p1 < 0.001) between acne scores follows up (pre, 2nd, 4th & 6th sessions) in subgroup B(Table 6). highly statistically significant difference (p1 < 0.001) between acne score follow up (pre, 2nd, 4th & 6th session) in subgroup C (Table 7). highly statistically significant difference (p1 < 0.001) between acne score follow up (pre, 2nd, 4th & 6th session) in subgroup D(Table 8).

Table 1. Comparison between studied groups as regard age & sex

		Group 1 (N = 30)		Group 2 (N = 30)		Test	p-value
Age (years)	Median	24.5		23.5		KW = 3.7	0.154 NS
	IQR	22 - 28		20 - 26			
Sex	Male	0	0%	0	0%	-----	-----
	Female	30	100%	30	100%		

KW: Kruskal Wallis Test, NS: p-value > 0.05 is considered non-significant

Table 2. Comparison between studied groups as regard acne score (2nd session)

2nd session		Group 1 (N = 30)		Group 2 (N = 30)		Test	p-value
Acne score	Median	22		21		445.5*	P = 0.947 NS
	IQR	15 - 27		17 - 26			
Acne score	Mild	9	30%	15	50%	2.5 **	P = 0.144 NS
	Moderate	21	70%	15	50%		
	Severe	0	0%	0	0%		

**: Mann-Whitney U, S: p-value < 0.05 is considered significant.*

*** : Chi-square test, NS: p-value > 0.05 is considered non-significant*

Table 3. Comparison between studied groups as regard acne score (4th session)

4th session		Group A (N = 30)		Group B (N = 30)		Group C (N = 30)		Group D (N = 30)		Test	p-value
Acne score	Median	12.5		14		23		18		409.5*	P1 = 0.546 NS
	IQR	7 - 17		10 - 17		19 - 24		15-22			
Acne score	Mild	30	100%	24	80%	6	20%	0	0%	6.66 **	P1 = 0.01 S
	Moderate	0	0%	6	20%	21	70%	7-23%			
	Severe	0	0%	0	0%	3	10%	23 -76.6%			

**: Mann-Whitney U test, S: p-value < 0.05 is considered significant*

*** : Chi-square test, HS: p-value < 0.001 is considered highly significant*

NS: p-value > 0.05 is considered non-significant

Table 4. Comparison between studied groups as regard acne score (6th session)

		Group-1(N = 30)				Group-2 (N = 30)				Test	p-value
6th session		Subgroup A		Subgroup B		Subgroup C		Subgroup D			
Acne score	Median	3.5		7		18.5		9.4		306*	P1 < 0.001 HS
										63*	P2 < 0.001 HS
	IQR	0 - 8		3 - 9		17 - 21		11-14		108*	P3 < 0.001 HS
Acne score	Mild	30	100%	22	73.3%	15	50%	9-30%		---	P1 = ----
	Moderate	0	0%	8	26.6 %	15	50%	21-70%		20 **	P2 < 0.001 HS
										20 **	P3 < 0.001 HS

*: Mann-Whitney U test, HS: p-value < 0.001 is considered highly significant

** : Chi square test

Table 5. Comparison between studied groups as regard acne score (6th session) in subgroup A

		Sub Group A								Test	p-value
Acne score		pre	2nd		4th		6th				
Acne score	Median	31.5	22		12.5		3.5		KW = 92.9	< 0.001 HS	
	IQR	25 - 36	15 - 27		7 - 17		0 - 8				
Acne score	Mild	0	0%	9	30%	30	100%	30	100%	X2 = 123.04	< 0.001 HS
	Moderate	15	50%	21	70%	0	0%	0	0%		
	Severe	15	50%	0	0%	0	0%	0	0%		

KW: Kruskal Wallis Test, HS: p-value < 0.001 is considered highly significant,

X*: Chi square test

Table 6. Comparison between studied groups as regard acne score (6th session) in subgroup B

		Sub Group B								Test	p-value
Acne score		pre	2nd		4th		6th				
Acne score	Median	29	21		14		7		KW = 81.7	< 0.001 HS	
	IQR	23 - 35	17 - 26		10 - 17		3 - 9				
Acne score	Mild	0	0%	15	50%	24	80%	30	100%	X2 = 92.6	< 0.001 HS
	Moderate	15	50%	15	50%	6	20%	0	0%		
	Severe	15	50%	0	0%	0	0%	0	0%		

KW: Kruskal Wallis Test, HS: p-value < 0.001 is considered highly significant. X2: Chi-square test

Table 7. Comparison between studied groups as regard acne score (6th session) in subgroup C

		Sub Group C								Test	p-value
		pre	2nd		4th		6th				
Acne score	Median	30	26.5		23		18.5		KW = 44.7	< 0.001 HS	
	IQR	25 - 35	22 - 29		19 - 24		17 - 21				
Acne score	Mild	0	0%	3	10%	6	20%	15	50%	X2 = 44	< 0.001 HS
	Moderate	15	50%	21	70%	21	70%	15	50%		
	Severe	15	50%	6	20%	3	10%	0	0%		

Table 8. Comparison between studied groups as regard acne score (6th session) in subgroup D

		Sub Group D								Test	p-value
		pre	2nd		4th		6th				
Acne score	Median	24	23.4		20		15.5		KW = 42.4	< 0.001 HS	
	IQR	25 - 32	19 - 25		19 - 24		17 - 21				
Acne score	Mild	0	0%	3	10%	6	20%	15	50%	X2 = 42	< 0.001 HS
	Moderate	15	50%	23	76.7%	21	70%	15	50%		
	Severe	15	50%	7	23%	3	10%	0	0%		



Fig. 1. Male patient of group I with subgroup A (Left) treated by IPL laser and Subgroup B(Right) treated by fractional CO2 laser



Fig. 2. Female patient of group II with subgroup A (Left) treated by IPL laser and Subgroup B(Right) treated by fractional CO2 laser

4. DISCUSSION

“Acne is a disease affecting the pilosebaceous unit resulting from increased sebum production, altered keratinization, inflammation, and bacterial colonization of hair follicles” [5].

Many treatments have been used for acne vulgaris including topical and oral agents. However, many side effects have been observed with these agents, such as the slow onset of action, limited efficacy, skin irritation, and recurrence [6]. “Furthermore, clinical trials that

were done to assess and compare the effectiveness of acne treatment options are either lacking or have used different designs and methodologies, resulting in a scarcity of strong evidence to support many of the recommendations in acne treatment guidelines. Hence, current guidelines rely on the opinions of experts. Furthermore, for acne associated with systemic diseases, therapeutic information is mostly at the level of case reports" [7].

"Newer therapeutic modalities such as light-based therapy have been developed to address the need for more efficacious and safer treatment. Several laser systems have been shown to destroy sebaceous glands, including near-infrared lasers and radiofrequency devices that act by thermally damaging the sebaceous glands" [8].

Yin R et al. [9] explained that "the therapeutic effects of fractional Co2 laser in acne were due to the induction of sebum output reduction due to sebaceous gland destruction, preventing acne scars and skin remodeling" [10]. On the other hand, intense pulsed light (IPL) therapy relies on the light absorption of porphyrins produced by *Cut bacterium acnes* bacteria resulting in a cytotoxic effect, but it does not target the sebaceous gland with a risk of recurrence due to bacteria repopulation.

This work aimed to study the treatment of different types of acne vulgaris by fractional Co2 laser and IPL in comparison to isotretinoin a comparative study to assess the potential role of their curative effect.

Our data showed a highly significant improvement in acne score in the Co2 laser-treated group when compared to IPL treated group in all sessions. A similar observation was reported by [9] that "compared the efficacy of Nd: YAG laser and IPL in inflammatory and noninflammatory acne lesions. In that study, subjects were randomly and equally assigned into two groups, the Co2 laser, and IPL groups. Each group received three sessions of laser 2 weeks apart. The co2 laser-treated group showed significant improvement between sessions when compared to IPL treated group".

On the other hand, our data disagreed with the results of [8] which reported no significant difference in the efficacy of the two therapies ($p>0.05$). That study included 72 subjects, each receiving 3 sessions of IPL on the right side of

the face and Co2 laser on the left side of the face at 4-week intervals.

Ilanosi S et al. [11] reported successful "treatment of a case of severe inflammatory acne in a pregnant Asian female with Co2 laser with near 100% reduction in active inflammatory acne lesions and overall improvement of skin texture".

Significant improvement was observed in IPL treated group at the end of treatment sessions but not as significant as in other treatment groups [12] reported that treatment of acne with IPL showed a significant reduction in the number of inflammatory lesions when compared to the control untreated group ($p<0.001$) [13]. also reported significant reductions (~30%) in the comedones and inflammatory lesions count ($p=0.0024$), however, this study lacked the presence of controls. In a study by [14], $\geq 90\%$ clearance or moderate improvement occurred in 29 out of 50 (58%) patients observed in IPL treated group. None of these studies included a Co2 laser as a comparator.

Co2 laser treatments showed a significant effect in the reduction of acne lesions. Similar findings were reported by [15] in which a sample of 88 subjects was treated with Co2 laser, Only 4 months of treatment were needed to produce at least 85% clinical improvement. Furthermore, in a study by [16] a good response was observed in 94.8% of the patients aged 12 to 20 years, and in 92.6% of the patients aged 21 to 35 years.

5. CONCLUSION

Regardless of reported complications in the Nd: YAG group, which resolved on continuing sessions, the significant improvement in non-inflammatory lesions and the absence of a significant flare-up of acne as seen among patients treated with IPL make Nd: YAG a better therapeutic modality for acne.

6. LIMITATION

Limitations of our study were the small patients' number, a short follow-up period, few treatment sessions, and not being a spilled-face study for a better comparison of the results.

CONSENT

As per international standard or university standard, patient(s) written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

The Research Ethics Committee in our institute only approves the studies based on the intention to treat.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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