

## **AIM OF THE WORK**

The aim of this study was to evaluate the use of fractional CO<sub>2</sub> laser in the treatment of photoaged skin.

## **PATIENTS AND METHODS**

### **Patients:**

The study was carried out on 50 patients presenting to the outpatient clinic of the department of dermatology of the Alexandria main university hospital for the treatment of photoaged skin. Patients were recruited for the trial between August 2012 and January 2014.

### **Inclusion criteria:**

Patients with photoaged skin according to Glogau's classification<sup>(25, 26)</sup>

### **Exclusion criteria included:**

- 1) Patients with Fitzpatrick skin type V , VI
- 2) Patients having active infections.
- 3) History of recurrent herpes infection.
- 4) Current pregnancy. <sup>(259)</sup>
- 5) History of isotretinoin treatment in the year before laser treatment. <sup>(259)</sup>
- 6) History of keloid or hypertrophic scarring.
- 7) Known allergy to topical anesthetics.
- 8) Any cosmetic procedure in the area(s) of treatment in the twelve months before the study.
- 9) Sun tanned individuals or those who were exposed to sun and sun beds in the week before treatment.

## **Methods**

### **Treatment protocol:**

All patients signed an informed consent, describing the treatment protocol and anticipated side effects and contraindications, prior to participation in the study.

### **History taking**

Patients were subjected to detailed history taking; including personal history (name, age, marital status and occupation).

### **Clinical Examination:**

Examination of the treated area for any signs of inflammation or infection was done. Examination of skin texture and pigmentation and rhytides (site and type) took place. Patient's skin type had been determined according to Fitzpatrick.<sup>(260)</sup>

### **Classification and the degree of photoaging assessed according to:**

- Glogau's<sup>(25, 26)</sup> classification of photoaging.
- Fitzpatrick wrinkle score.<sup>(24)</sup>
- Comprehensive grading scale of rhytides, laxity and photodamage<sup>(23)</sup>

A clinical photo was taken using 5 mega pixel camera .And photos for wrinkles and pores and pigments were taken using 1.3 mega pixel camera (CCL-215 USB) which were analyzed using skinSYS software.

Immediately before starting the procedure, any creams and cosmetic residues were meticulously removed with saline solution and a topical anaesthetic was applied and left for 30minutes.patient were examined for anaesthetic hypersensitivity. Patients' eyes were covered with protective glasses during the entire procedure. The laser was applied as one pass of pulses over the area to be treated without overlap or gaps between pulses.

After treatment a topical antibiotic was applied followed by sunscreen and patients were instructed to gently cleanse the treated area and apply Mebo™ cream two to three times per day (to maintain moisture) until complete shedding of crusts and scales. They were also advised to stay away from direct sun exposure till complete re-epithelization and use sunblock between sessions and to refrain from picking and rubbing the skin.

Patients were reassessed according to Glogau's classification of photoaging and Fitzpatrick wrinkle score and comprehensive grading scale. Photographs were taken before each session and at the end of three months follow up period. A patient satisfaction survey was done at the end of follow up period.<sup>(261)</sup>

Each patient received monthly sessions for three sessions. Follow up was done at the end of three months follow up period.

**Technical data:**

The study was performed with a 10,600nm prototype CO<sub>2</sub> medical laser system (ATL-250)<sup>(262)</sup> built by Advanced Technology Laser Company, Ltd. ,Shanghai, China. This laser system uses 630nm red diode laser as a second "aiming" laser parallel to the CO<sub>2</sub> laser that allows the laser beam operator to focus the beam properly. Aiming beam is delivered through an articulated arm.

The device is equipped with a scanner, which allows ablation of small holes in skin at (100μs-10ms) pulse width and adjustable scanning size and pattern and array density. In the study, the scanning mode was used. Treatment parameters were set as follows: power was 4-6 W, PPI (array density) was 4 and time was 3-4 ms, one pass only was applied to the treated area per session. The shape of scanning area was set to rectangle with area-a and b were 9.

Clinical photographs were were taken by 5 mega pixels camera, Samsung , China.The (CCL-215 USB) Coscam camera <sup>(263)</sup> used for photographing is a 1.3 mega pixel camera. The following accessories were used in this study: x100 lense and 4 caps specified for skin analysis. The results were analyzed using SkinSYS software. The scoring system by SkinSYS software ranges from one to five where 1 indicate very high (worst /largest) while five indicates very low (best/smallest).

**The used caps were:**

- X12 vertical illuminating cap (partial contact type) for wrinkles
- X100 side illuminating cap (contact type )for pore size
- X14 polarized filter cap (contact type) for skin pigmentation.



**Figure (2):** 10,600nm prototype CO<sub>2</sub> medical laser system (ATL-250)



**Fig. 4a**



**Fig. 4b**

**Figure (3):** Fig.4a : (CCL-215 USB) Coscam camera.Fig4b :Coscam camera caps

### **Statistical analysis of the data <sup>(264)</sup>**

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0.<sup>(265)</sup> Qualitative data were described using number and percent. Quantitative data were described using Range (minimum and maximum), mean, standard deviation and median. The distributions of quantitative variables were tested for normality using Kolmogorov-Smirnov test, Shapiro-Wilk test and D'Agstino test, also Histogram and QQ plot were used for vision test. If it reveals normal data distribution, parametric tests was applied. If the data were abnormally distributed, non-parametric tests were used. For abnormally distributed data, comparison between two stages were done using Wilcoxon signed ranks test. Significance of the obtained results was judged at the 5% level.

## **RESULTS**

This study was conducted on 50 female patients, showing manifestations of photoaged skin according to Glogau's classification. Patients were recruited from the Dermatology outpatient clinic of the main University Hospital, Faculty of Medicine, University of Alexandria. No males agreed to participate in the study.

### **Demographic data:**

The age of the patients in the present study ranged from 29 to 64 years, with a mean age of  $46.4 \pm 8.79$  years. Forty four percent of the patients not working, while the 56% were working. (Table 5).

**Table (5): Distribution of the studied cases according to demographic data:**

	<b>No.</b>	<b>%</b>
<b>Sex (n=50)</b>		
Male	0	0.0
Female	50	100.0
<b>Age (n=50)</b>		
Min. –Max.	29.0 – 64.0	
Mean $\pm$ SD	$46.40 \pm 8.79$	
Median	47.0	
<b>Work (n=50)</b>		
Not working	22	44.0
Working	28	56.0

**Clinical data:**

According to Fitzpatrick skin phototypes, 56% of patients were type III, 36% were type IV and only 8% were type II (Table 6).

**Table (6): Distribution of studied sample according to Fitzpatrick skin phototype:**

	No.	%
<b>Skin Type (n=50)</b>		
TypeII	4	8.0
TypeIII	28	56.0
TypeIV	18	36.0

Glogau’s photoaging classification before treatment ranged from 2.0 to 3.0 (mean ± SD = 2.84±0.37). No change in Glogau photoaging classification was detected in patients after treatment. Hence, the difference in Glogau photoaging classification before and after fractional CO<sub>2</sub> treatment was non-significant (p=1.000) (Table 7).

Fitzpatrick wrinkle score before treatment ranged from 1.0 – 8.0 (mean ± SD= 4.96±1.50), whereas after treatment it ranged from 1.0 – 7.0 (mean ± SD= 4.67±1.45). No significant difference regarding the Fitzpatrick wrinkle score before and after treatment was detected (p=0.077) (Table 8).

**Table (7): Distribution of the studied cases according to Glogau’s photoaging classification and Fitzpatrick wrinkle score before and after**

	Before	After	P
<b>Glogau’s photoaging classification</b>	<b>(n =50)</b>	<b>(n = 50)</b>	
Min.-Max	2.0 – 3.0	2.0 – 3.0	
Mean ± SD	2.84 ± 0.37	2.84 ± 0.37	1.000
Median	3.0	3.0	
<b>Fitzpatrick wrinkle score</b>	<b>(n =50)</b>	<b>(n =50)</b>	
Min.-Max	1.0 – 8.0	1.0 – 7.0	
Mean ± SD	4.96 ± 1.50	4.67 ± 1.45	0.077
Median	5.0	4.0	

p: p value for Wilcoxon signed ranks test for comparing between before and after

Comparing between follow up score and before first session score using Comprehensive grading scale resulted in the following:

- There was significant Improvement in wrinkles
- There was no significant improvement in all other parameters of the scale

## Results

**Table (8): Comparison according to comprehensive grading scale for rhytides, laxity and photodamage (n = 50)**

	wrinkle	Laxity	Elastosis	Dyschromia	Erythema	Keratosis	Texture	Overall	Pt. satisfaction
<b>Before 1st session</b>									No (20%) Yes (80%)
Min.– Max.	2.0-3.50	1.50-3.50	0.0-2.50	0.0-3.50	0.0-2.50	0.0-2.0	0.0-4.0	7.50-19.50	
Mean ± SD	2.79±0.51	2.67±0.61	0.71±0.74	2.73±1.12	0.60±0.78	0.44±0.61	2.71±1.22	12.65±3.67	
Median	3.0	3.0	1.0	3.25	0.0	0.0	3.50	12.50	
<b>At 3 months follow up period</b>									
Min.– Max.	2.0-3.50	1.50-3.50	0.0-2.50	0.0-3.50	0.0-2.50	0.0-2.0	0.0-4.0	6.0-19.50	
Mean ± SD	2.75±0.51	2.67±0.61	0.71±0.74	2.73±1.12	0.66±0.79	0.44±0.61	2.65±1.31	12.61±3.74	
Median	3.0	3.0	1.0	3.25	0.0	0.0	3.50	12.50	
<b>P</b>	0.046*	1.000	1.000	1.000	0.157	1.000	0.063	0.473	

p: p value for Wilcoxon signed ranks test for comparing between before and after

\*: Statistically significant at  $p \leq 0.05$

Patients satisfaction was determined according to a 4 points scoring system (1=poor, 2=good, 3= very good and 4= excellent)

Results of the present study revealed that 20% of patients were poorly satisfied with the treatment results, 36% of patients rated their improvement as good. 44% rated it very good. No patient showed excellent improvement (Table 9).

**Table (9): Distribution of the studied cases according to Patients satisfaction (4 points scale)**

	No.	%
<b>Patients Satisfaction (n=50)</b>		
1( poor)	10	20.0
2 (good)	18	36.0
3 (very good)	22	44.0
4 (excellent)	0	0.0

## Results

### Results of Coscam camera photos before each session and at the end of a 3 month follow up period:

The scoring system by SkinSYS software- used to analyze Coscam camera photos- ranges from one to five where 1 indicate very high (worst /largest)while five indicates very low(best/smallest).

#### 1) Regarding wrinkles:

There was no statistically significant difference in wrinkles when photos before each successive sessions were compared and on comparing each photo to photos before 1<sup>st</sup> session. (Table10)

**Table (10): Comparison between the four photos regarding the Wrinkles (n = 50)**

	Before 1 <sup>st</sup> session	Before 2 <sup>nd</sup> session	Before 3 <sup>rd</sup> session	Follow up
<b>Wrinkle</b>				
Min.– Max.	1.0 – 4.0	1.0 – 5.0	1.0 – 2.0	1.0 – 2.0
Mean ± SD	1.40 ± 0.70	1.68 ± 0.89	1.52 ± 0.50	1.48 ± 0.50
Median	1.0	2.0	2.0	1.0
<b>p<sub>1</sub></b>		0.059	0.188	0.252
<b>p<sub>2</sub></b>		0.059	0.442	0.593

p<sub>1</sub>: p value for Wilcoxon signed ranks test for comparing between 1<sup>st</sup> session and each other sessions

p<sub>2</sub>: p value for Wilcoxon signed ranks test for comparing between each two successive sessions

\*: Statistically significant at  $p \leq 0.05$

#### 2) Regarding pores

There was a statistically significant improvement in pores size when photos before 3<sup>rd</sup> sessions and photos before 2<sup>nd</sup> session in the studied group were compared ( $p=0.021$ ). A statistically significant improvement in pores size also appeared when photos before the 3<sup>rd</sup> session and follow up photos were compared to the baseline( $p=0.005$  and  $p= 0.020$  respectively).(Table 11 )

**Table (11): Comparison between the four photos according to Pores (n = 50)**

	Before 1 <sup>st</sup> session	Before 2 <sup>nd</sup> session	Before 3 <sup>rd</sup> session	Follow up
<b>Pores</b>				
Min.– Max.	1.0 – 5.0	2.0 – 5.0	1.0 – 5.0	2.0 – 5.0
Mean ± SD	2.84 ± 1.09	3.0 ± 0.86	3.52 ± 1.11	3.44 ± 0.91
Median	3.0	3.0	3.0	3.0
<b>p<sub>1</sub></b>		0.462	0.005*	0.020*
<b>p<sub>2</sub></b>		0.462	0.021*	0.383

p<sub>1</sub>: p value for Wilcoxon signed ranks test for comparing between 1<sup>st</sup> session and each other sessions

p<sub>2</sub>: p value for Wilcoxon signed ranks test for comparing between each two successive sessions

\*: Statistically significant at  $p \leq 0.05$

## Results

### 3) Regarding pigmentation:

Comparison between photos before 2<sup>nd</sup> sessions and photos before 3<sup>rd</sup> session in the studied group revealed a significant improvement in pigmentation ( $p=0.025$ ) (Table 12).

Comparison of before 3<sup>rd</sup> session photos and follow up photos to the baseline showed also statistically significant improvement in pigment ( $p<0.001$ ,  $p=0.004$  respectively).

However, comparison of photos before 1<sup>st</sup> session with those before 2<sup>nd</sup> session revealed non-significant results. Similarly, comparison between photos before the 3<sup>rd</sup> session and follow up photos yielded non-significant results (table 12).

**Table (12): Comparison between the four photos according to Pigment (n = 50)**

	Before 1 <sup>st</sup> session	Before 2 <sup>nd</sup> session	Before 3 <sup>rd</sup> session	Follow up
<b>Pigment</b>				
Min.– Max.	1.0 – 3.0	1.0 – 3.0	1.0 – 5.0	1.0 – 5.0
Mean $\pm$ SD	1.24 $\pm$ 0.59	1.48 $\pm$ 0.76	2.04 $\pm$ 1.55	1.80 $\pm$ 1.25
Median	1.0	1.0	1.0	1.0
<b>p<sub>1</sub></b>		0.145	<0.001*	0.004*
<b>p<sub>2</sub></b>		0.145	0.025*	0.386

p<sub>1</sub>: p value for Wilcoxon signed ranks test for comparing between 1<sup>st</sup> session and each other sessions

p<sub>2</sub>: p value for Wilcoxon signed ranks test for comparing between each two successive sessions

\*: Statistically significant at  $p \leq 0.05$

**Complications:**

Analysis of the studied sample showed that from 150 sessions: 8% of sessions were followed by post inflammatory hyperpigmentation, 5.3% were followed by inflammation, only 1.3% were followed by residual erythema. Anesthetic hypersensitivity occurred in 1.3% of the sessions. (Table 13). At follow up 4 patients only showed persistent hyperpigmentation. (Table 14)

**Table (13): Distribution of complications in performed sessions:**

(n=150 session)	No.	%
<b>Complications</b>		
PIH	12	8
inflammation	8	5.3
Residual mild erythema	2	1.3
Anesthetic hypersensitivity	2	1.3

**Table (14): Distribution of the studied cases according Complications at follow up**

(n=50 session)	No.	%
<b>Complications</b>		
PIH	4	8

There was no significant correlation between age or skin type and patient satisfaction or complications or any significantly improved parameter.

## Cases Presentation



Fig 4a



Fig 4b

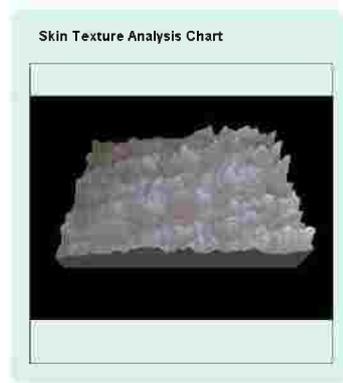


Fig 4c

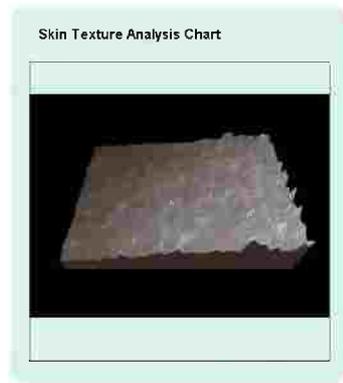


Fig 4d

**Continue Figure (4)**



Fig 4e

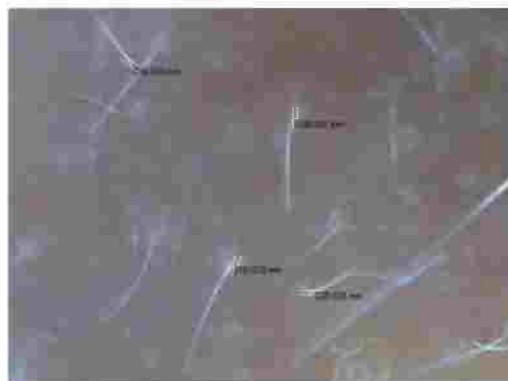


Fig 4f



Fig 4g

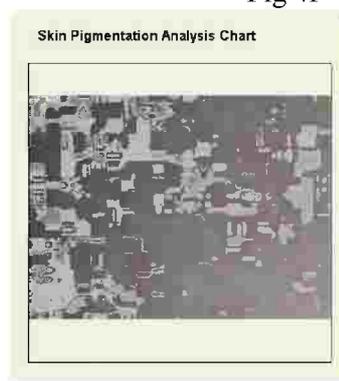
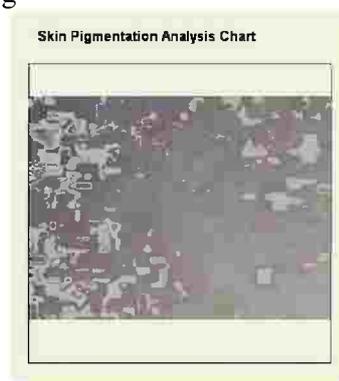


Fig 4h



**Figure (4):** A female patient, 54 years old, Fitzpatrick photo-type IV Glogau's type was 3 before and after treatment, Fitzpatrick wrinkle score improved from II6 to II5 after treatment. Comprehensive grading scale overall score was 13 before and after treatment. Figure 4a is a clinical photo before first session and Figure 4b is a clinical photo at the end of 3 months follow up period. Figures from 4c-4h are Coscam photos and their analysis charts. Fig. 4c: Coscam Wrinkle score before first session is 1. Fig. 4d: Coscam wrinkle score at the end of follow up period is 1. Fig. 4e: Coscam pores score before first session is 5. Fig. 4f: Coscam pores score at follow up is 3. Fig. 4g: Coscam pigmentation score before first session is 1. Fig. 4h: Coscam pigmentation score at follow up period is 1.



Fig 5a



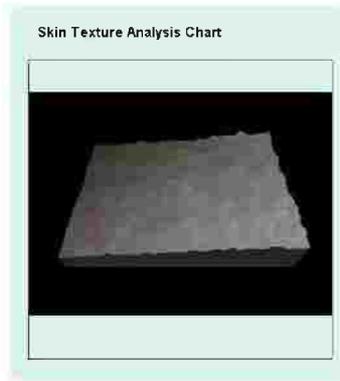
Fig 5b



Fig 5c



Fig 5d



Continue Figure (5)

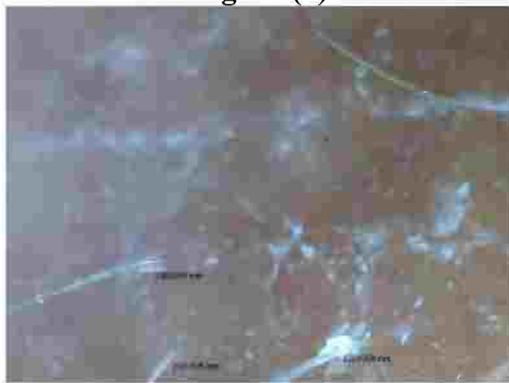


Fig 5e

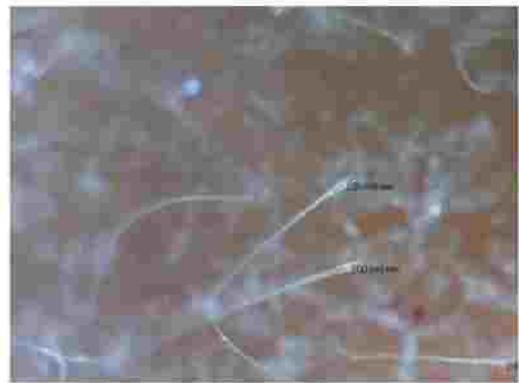


Fig 5f



Fig 5g

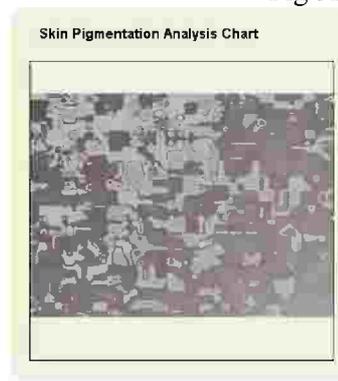
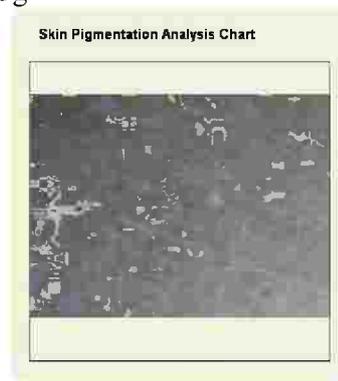


Fig 5h



**Figure (5):** A female patient, 41 years old, Fitzpatrick photo-type IV Glogau's type was 3 before and after treatment, Fitzpatrick wrinkle score improved from II5 before and after treatment. Comprehensive grading scale overall score increased from 11 before to 12.5 after treatment due to development of post laser erythema. Figure 3a is a clinical photo before first session and Figure 5b is a clinical photo at the end of 3 months follow up period. Figures from 5c-5h are Coscam photos and their analysis charts. Fig. 5c: Coscam Wrinkle score before first session is 1. Fig. 5d: Coscam wrinkle score at the end of follow up period is 1. Fig. 5e: Coscam pores score before first session is 2. Fig. 5f: Coscam pores score at follow up is 3. Fig. 5g: Coscam pigmentation score before first session is 1. Fig 5h: Coscam pigmentation score at follow up period is 4



Fig 6a



Fig 6b



Fig 6c



Fig 6d

Continue Figure (6)



Fig 6e



Fig 6f



Fig 6g

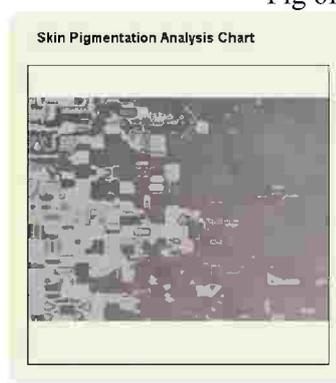
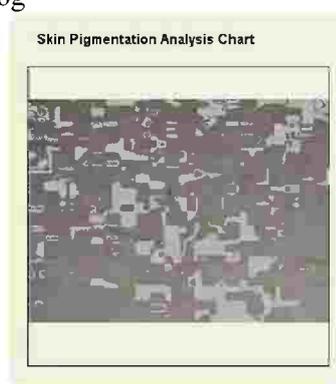


Fig 6h



**Figure (6):** A female patient, 51 years old, Fitzpatrick photo-type II Glogau's type was 3 before and after treatment, Fitzpatrick wrinkle score improved from II5 to II4 after treatment. Comprehensive grading scale overall score was 15.5 before and after treatment Figure 6a is a clinical photo before first session and Figure 6b is a clinical photo at the end of 3 months follow up period. Figures from 6c-6h are Coscam photos and their analysis charts. Fig. 6c: Coscam Wrinkle score before first session is 1. Fig. 6d: Coscam wrinkle score at the end of follow up period is 1. Fig. 6e: Coscam pores score before first session is 2. Fig. 6f: Coscam pores score at follow up is 5. Fig. 6g: Coscam pigmentation score before first session is 2. Fig. 6h: Coscam pigmentation score at follow up period is 3.



Fig 7a



Fig 7b



Fig 7c



Fig 7d



**Continue Figure (7)**



Fig 7e

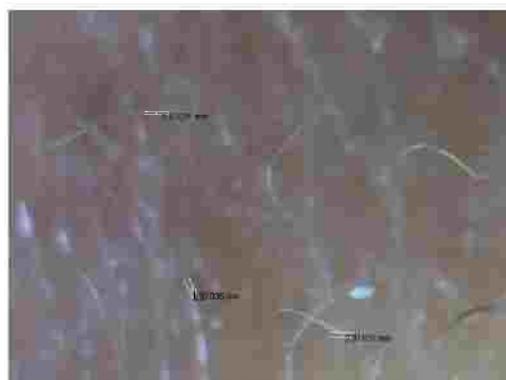


Fig 7f



Fig 7g

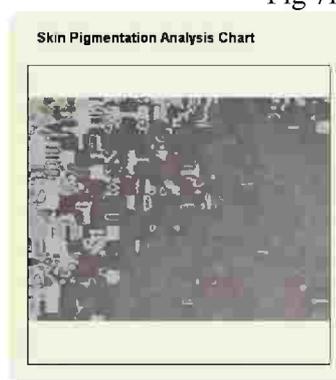
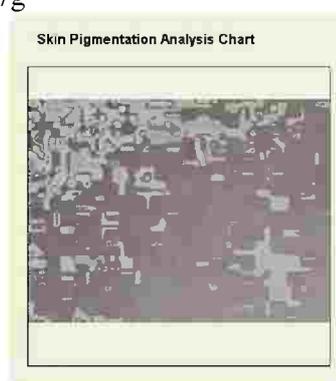


Fig 7h



**Figure (7):** A female patient, 53 years old, Fitzpatrick photo-type IV Glogau's type was 3 before and after treatment, Fitzpatrick wrinkle score was II4 before and after treatment. Comprehensive grading scale overall score was 15 before and after treatment. Figure 7a is a clinical photo before first session and Figure 7b is a clinical photo at the end of 3 months follow up period. Figures from 5c-5h are Coscam photos and their analysis charts. Fig. 7c: Coscam Wrinkle score before first session is 1. Fig. 7d: Coscam wrinkle score at the end of follow up period is 2. Fig. 7e: Coscam pores score before first session is 3. Fig. 7f: Coscam pores score at follow up is 3. Fig. 7g: Coscam pigmentation score before first session is 1. Fig. 7h: Coscam pigmentation score at follow up period is 1.



**Figure (8):** A case developed inflammation at chin area after second session.