

## Evaluation of Efficacy and Safety of Fractional CO<sub>2</sub> in Management of Facial Scars in Type IV and V Skin Type

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### ABSTRACT

**Background:** Despite the evolution of new modalities in management of scars, facial scar management remains a challenging task. Not only due to its psychological effect on the patients, but also due to their high unrealistic expectations. Fractional CO<sub>2</sub> laser proved to be safe and effective method in treating facial scars regardless its etiology.

**Patients and Methods:** Thirty patients with post-traumatic facial scar were recruited. All of them have skin type IV and V. They were treated with fractional CO<sub>2</sub> laser. Patients were photographed after each session and photos were examined by two independent investigators. Patient satisfaction was also evaluated and graded.

**Results:** About 70% of the patients had improvement in their scar appearance and 30% had no improvement at all. 20% had self-limited complications that resolved with treatment.

**Conclusion:** Fractional CO<sub>2</sub> is effective method in management of post traumatic facial scars. Yet some precautions should be taken in patients with type IV and above skin color to minimize complications.

**Key Words:** Fractional CO<sub>2</sub> – Facial – Scars.

### INTRODUCTION

Patients with facial scars have severe psychological distress. Unfortunately, their management remains challenging. Many treatments regimens are available to improve the appearance of the scars but all of them have results vary from none to moderate aside from unpredictable complications. On the other hand patients with facial scars usually have unrealistic expectations. So, a detailed, honest, realistic pre-treatment examination and counseling should be done before any attempt of starting treatment [1].

There are many options for managing these facial scars includes surgical correction, dermabrasion or laser resurfacing techniques whether ablative or non ablative. Lasers used for resurfacing

of scars are divided into non ablative and ablative lasers. Laser resurfacing techniques are supposed to work by stimulating collagen production and remodeling of dermal collagen fibers [2].

CO<sub>2</sub> laser vaporizes tissue at depth of 20:60um and thermal necrosis zones ranging another 20:50um energy at 10.600um wavelength is absorbed by both intracellular and extracellular water, causing rapid heating and vaporization [2].

Dermal heating below the zone of ablation induces a wound-healing response [3,4] which leads to heat-mediated tissue contraction and collagen remodeling. Re-epithelialization usually takes 5-10 days, and erythema may persist for months [3].

Side effects may include dyschromia (hyper- or hypopigmentation), infection, demarcation lines between treated and untreated areas and scarring [3,5,6].

Post-inflammatory hyper-pigmentation is a reactive hypermelanosis of the skin that occurs as a consequence of an inflammatory process [7]. Patients with high skin phototype are at high risk of post-inflammatory hyper-pigmentation than other patients of lower skin phototype [8].

Using aggressive parameters in Fractional CO<sub>2</sub> resurfacing may result in adverse effects such as scarring comparable to those of fully ablative CO<sub>2</sub> laser resurfacing [9].

### PATIENTS AND METHODS

In our study we aim to assess the efficacy and safety of fractional CO<sub>2</sub> in management facial scars and rate of complications.

Thirty patients were involved in our study. They were managed in the period from April 2015 –

February 2016. All of them have posttraumatic facial scars more than 3 months ago. Skin type IV and V. Any patient underwent any previous laser treatment or filler or steroid injections were excluded.

*Pretreatment regimen:* 1 month of prophylactic bleaching agent and sunscreen was prescribed to all patients.

*Treatment session:* Topical anesthetic was applied half an hour before the procedure. Photographs were taken before each session. Fractional CO<sub>2</sub> laser was done (Dekka). The parameters of the laser treatment were fixed for all patients. Power: 15W, D well time: 700µsec, Spacing: 700 and Stack: 2. Topical antibiotic was applied immediately after the session.

*Post treatment regimen:* Topical antibiotic twice daily for one week post session. Bleaching agent was started one week post session and continued till the next session. Interval between sessions was four to six weeks. Assessment was done after forth session. One month and three months post session's assessment was done.

Assessment was done using the Vancouver scar scale before the first session and after the last session (Table 1). Patient's questionnaire was filled by the patient after completion of sessions (Table 2). Patient replied by either yes, no, or I don't know. Photographic assessment of the patient was done by two independent investigators both are

board certified plastic surgeons. They compare the pre and post treatment photographs giving each patient a scale from 1-10; one being the least improvement while ten is the maximum improvement.

Table (1): Vancouver scar scale.

<i>Pigmentation:</i>		
0	Normal	Resembles nearby skin
1	Hypopigmented	
2	Hyperpigmented	
<i>Vascularity:</i>		
0	Normal	
1	Pink	Slightly increase in local blood supply
2	Red	Significant increase in local blood supply
3	Purple	Excessive increase in local blood supply
<i>Pliability:</i>		
0	Normal	
1	Supple	Flexible with minimal resistance
2	Yielding	Giving way to pressure
3	Firm	Solid/inflexible, not easy moved, resistant to manual pressure
4	Banding	Rope like, doesn't limit the range of motion
5	Contracture	Shortening of the scar produce deformity, limit the range of motion
<i>Height mm:</i>		
0	Normal (flat)	
1	Less than 2mm	
2	2:5mm	
3	More than mm	

Table (2): Patients' satisfaction questionnaire.

- 1- Were you satisfied with your fractional CO<sub>2</sub> laser treatment?
- 2- Would you recommend the procedure to your friend?
- 3- Would you have the procedures again if you needed?
- 4- Were the results of the treatments worth the time and cost invested?
- 5- The most significant improvement in my skin after the laser treatment was:
  - a- Color.
  - b- Smoothness (lines/wrinkles).
  - c- Improved (tone/tightness).
- 6- Did you experience any problems with the laser treatment?
- 7- Did the pain was tolerable with topical anesthesia?
- 8- How long post session erythema lasts?

## RESULTS

Thirty patients were involved in this study from the period from April 2015 – February 2016. All of them completed the sessions. The mean follow-up period is 3 months. All patients have post-traumatic facial scars. The patients' ages ranges from 18-50 years with the mean of 23.4 years. Male to female ratio was 2:1. Duration of the scar

ranges from 1: 20 years with the mean of 5.7 years. All of them were post traumatic scars.

Side effects in this study were mild including hyper-pigmentation, hypertrophic scar and pustules.

### *Vancouver scar scale evaluation:*

The scars were assessed before starting the sessions using the Vancouver scar scale. Of thirty

patients 19 (64%) patients shows clinical improvement with down scaling of their scar scale. Six patients (20%) have depressed scars. They show marked clinical improvement but without down scaling of their scar because Vancouver scar scale grade the hypertrophic scars not the depressed one. 5 patients (16%) were complicated 4 developed hyperpigmentation so, their scale was upgraded. One patient developed hypertrophic scar and her scale became six instead of four.

#### Photographic evaluation:

The pre and post treatment session were evaluated by two independent blinded observers. They grade the improvement of the scar to be from one to ten. Grade one is the least improvement and ten as maximum improvement. The mean of the two grades was taken.

By comparing the photographs before and after three month of the treatment 14 patients has been evaluated to have  $\geq 50\%$  improvement (Figs. 1,2). While 7 patients has been evaluated to have  $\leq 50\%$  improvement. 9 patients evaluated to have no improvement (Fig. 3).

#### Patients' questionnaire:

The patient's satisfaction was assessed through a nine question questionnaire that was fulfilled by the patients by the end of their sessions.

General satisfaction of the treatment modality was 66%. More than 90% of the patients will recommend it to their friends, and nearly all of them will use it in the future if they are subjected to future scarring. More than 85% of the patients see that the laser was cost effective regarding the cost, the time and the effort.

Regarding the aspect of improvement of the scars. The questions included the color, texture, and suppleness of the skin. Most of the patients feel improvement in the suppleness of the scar (50%), 66% feel texture improvement, and 33% shows color improvement.

The average duration of erythema was 7 days. Only 10% shows no erythema and 13% the erythema lasts for more than 7 days.

Regarding the complication rate it was 20%. One of them was skin infection, one other patient develop hypertrophic scar (Fig. 4), and four patients developed hyperpigmentation (Fig. 5).

Table (3): Vancouver assessment of scars.

Scar scale	Total number	Improved	Depressed scars (improved)	Complicated
1	6	4	2	–
2	6	2	3	1
3	7	4	1	2
4	3	2	–	1
5	2	2	–	–
6	4	3	–	1
7	1	1	–	–
8	1	1	–	–

Table (4): Patient's satisfaction questionnaire.

1- General satisfaction:	
Satisfied	20
Satisfied provided improvement of service	10
Not satisfied	0
2- Recommendation to a friend:	
Yes	28
I don't know	2
No	0
3- Same management in the future:	
Yes	29
I don't know	1
No	0
4- Cost effectiveness:	
Yes	26
No	4
5- Skin improvement:	
Yes	27
No	3
a- Color improvement:	
Yes	13
No	17
b- Texture:	
Yes	20
No	10
c- Suppleness:	
Yes	15
No	15
6- Complications:	
Yes	6
No	24
7- Tolerance to pain:	
Yes	19
Yes with topical anesthesia	12
No	3
8- Duration of erythema:	
No	3
<7 days	23
>7 days	4



Fig. (1): Skin type IV patient with improved texture and pliability of facial scar after four sessions.



Fig. (2): Skin type IV patient with improved texture and color of facial scar after four sessions.



Fig. (3): Depressed glabellar scar shows no improvement after four sessions.



Fig. (4): Skin type IV patient developed hypertrophic scarring post two sessions.





Fig. (5): Skin type V patient with hyperpigmentation post first laser treatment session.

## DISCUSSION

In most of post traumatic facial scars even with meticulous wound closure some of them will depress and/or widen over time. It is likely due to inadequate replacement of collagen fibers in the underlying dermis [10]. It is considered as stigmata to patients. Most of patients seeking management to their facial scars have false high expectations. Proper pretreatment counseling should be done before starting the management, to tailor the best scar management modality/regimen for each patient.

In our study we tried to evaluate the efficacy of fractional CO<sub>2</sub> laser in improving the appearance of the post-traumatic facial scars.

Fractional CO<sub>2</sub> greatly affect the pliability of the scars tissues and texture of the treated skin. It produces its effect through collagen remodeling after controlled micro thermal zones of injury.

Yet some depressed wide scars need addition of another modality to improve the results, such as fillers or fat injections.

One of our outcome assessment tools was the Vancouver scar scale. There is a difference in the percentage of scar improvement between the Vancouver scale and the photographic assessment of the patients (84% Vs 70% respectively) because improvement of scar pliability can't be photographically assessed.

The Vancouver scar scale shows deficiency in depressed scars assessment as it assesses only the scar height rather than the depth. So, some of our patients show clinical improvement but this not affects their scar scale.

The difficulty that we were confronted with is the higher skin type of our patients and the inevi-

table post session sun exposure. They are more liable to post treatment hyper-pigmentation. The rate of hyper-pigmentation in our patients was 13% compared to other published studies 1.3% [11].

The incidence of hyperpigmentation is more than 37% in patients treated with a fully ablative CO<sub>2</sub> laser device. Postinflammatory hyperpigmentation was not observed in any subject who treated with fractional CO<sub>2</sub> in the study published by Tan et al. [12]. Although this study includes seven patients only.

Chin et al., studied the incidence of post inflammatory hyperpigmentation in 37 Asian patients after fractional laser treatment. The incidence was 7.1%-12.4% dependent on the used density and energy. They recommend using cooling to prevent bulk tissue heating so decreases the incidence of hyperpigmentation [13]. Where the effect of cooling on tissue inflammatory response needed for collagen remodeling remains of question and needs further studies to be evaluated.

Another complication occurred in our study is hypertrophic scar in one patient. Which necessitate stoppage of the treatment session and start intralesional steroid injection.

## Conclusion:

Post-traumatic facial scars affect the patient psychology greatly. Most of patients who seek management have a false high expectation. Fractional CO<sub>2</sub> can greatly improve their appearance. The complication rate is high in patients with darker skin types. So, proper choose of parameters as well as strict use of post session sun protection creams and bleaching agents before starting the sessions and in between them may help in decreasing the pigmentary changes. Yet some patients will need a complementary modality to improve the results.

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