

The Efficacy of fractional CO₂ laser in management of surgical wound scars

Abbas M, suhan*, Maha, Darweesh**

ABSTRACT

Background: Atrophic postoperative and traumatic scarring are common cosmetic problems for patients. Combining CO₂ laser ablation with a fractional photothermolysis system in a treatment known as ablative fractional resurfacing fulfilling the new demands for a lesser risk of side effects and minimal or no downtime.

Objective: To assess the safety and efficacy of ablation fractional CO₂ laser treatments for surgical scarring .

methods: Twenty one patient (14 women, and 7 men) with various skin types , I to IV , aged 3 to 48 years , presents with 24 scars between June and December 2012 , four patients excluded from study because they are not continued in follow up , the remaining 17 patient completed all 3 treatments & 6 months follow up.

Results: Adverse effects of treatment were mild to moderate , and no scarring or delayed onset hypopigmentation was observed, For all patients demonstrated improvements in skin texture and

reduction of pain and discomfort and improvement of tenderness and hardness of the scar which become more soft and mature .

Conclusions: The ablation CO₂ laser treatment represent safe , effective treatment modality for improving scar quality , texture, maturation and appearance.

Keywords: Ablative fractional lasers, CO₂ lasers, traumatic scars, atrophic scars.

*Al-Kindy College Medical Journal 2014: Vol. 10 No. 2
Pages: 73-76*

**Department of plastic surgery, AL-Wasity hospital, Baghdad , Iraq.*

***Department of maxilla facial surgery, AL-Wasity hospital, Baghdad, Iraq.*

Received 15 July 2014 accepted in final 27 August 2014

*Corresponding to Dr Abbas Mohamed Suhan. email:
abbas_alsahan@yahoo.com*

Carbon dioxide (CO₂) lasers have been successfully used for many years to treat surgical, atrophic ,and acne scars. High-energy short pulses from the 10600-nmCO₂ laser rapidly vaporize water, intracellularly and extracellularly, which creates precise levels of tissue ablation and minimizes extraneous dermal injury and scarring^{1, 2}. Resurfacing with theCO₂ laser ablates and smoothes the skin surface to precise tissue depths, and the deeper thermal coagulation of the dermis drives robust remodeling and neocollagenesis, which correspond to clinical improvement in atrophic scars³.

The advent of fractional photothermolysis (FP) revolutionized the field of laser surgery by delivering light energy in a unique beam pattern^{4,5} light to create columns of tissue coagulation in a pixilated pattern (also known as microthermal zones [MTZs]) just below the skin surface. These MTZs are separated by healthy, untreated tissue and protected by an intact overlying epidermis. Density and depths of MTZs can be modified according to the desired clinical result. The presence of an intact overlying epidermis and healthy tissue surrounding each MTZ results in rapid healing and significantly shortened recovery time^{6, 7}. The most commonly observed post treatment adverse effects of FP are transient and mild and include erythema, edema, dryness, pruritus, and bronzing^{8, 9}.

Methods. All procedures have been conducted at institute of laser for post graduate study and at laser center at Al .Wasity Hospital in Baghdad, Iraq. Twenty one patients with twenty four scars completed the six months follow up visit after the final treatment by scanned CO₂ laser . Four patients (with 4 scar) did not continued the follow up and the remaining 17 patients completed the follow up of the study in average duration between 12-24 weeks.

CO₂ laser system (10600nm) emits laser in variable modes (continuous, single pulse, repetitive pulse, scanned , and ultra pulse) . Other Equipments and instruments : Surgical gowns, Surgical gloves, facial masks, sterile gowns, sterile normal saline 0.9%, Xylocaine spray 2%,

xylocaine injection 1% and eye protection goggle, water bottles.

A thorough history from each patient about medical illnesses especially herpes simplex to those with facial scars, any history of previous medications used for scar which may important to improve the result of scar, example Hydroquinone 4% cream or use of fibrinolytic agent like contractubex gel (trade name). It was imperative to examine the scar properly especially the fresh wound scars where the sutures taken off earlier, the examination include evaluation of any stitch abscess or inflammations and dehiscence which need to be controlled first.

Preoperative consultation is to find out the patient expectations and agreements about the results ,and need to exclude those patients who have unrealistic expectations . After the patients goals had been discussed and reasonable expectation , informed consent was discussed.

The potential complications should be discussed including , mild pain and discomfort during and after applications of laser therapy , hyperpigmentation hypopigmentation and redness which may last few days to weeks according to sites and color of skin.

The scars wiped with gauze containing alcohol , 70 % , and anesthetized with either local xylocaine spray 2 % or subcutaneous lidocaine hydrochloride 1 % injection , with hypoderm needle 10 to 15 minutes before the procedure. Prophylactic acyclovir hydrochloride was not administered to patient because lesion far from peri-oral area and no history of herpes simplex lesion before. Prior to treatment with CO₂ laser , moist drapes were placed around the field and the patients eye protected with proper eye shields .

All treatment were performed with CO₂ laser using scanned mode power energies ranged formed 5-10 w according to site of lesion where 5 w used in facial scars and 10 w for abdomen and breast scar.It is usually applied low energy to thin skin and high energy to thick

skin.

The hand piece used to deliver the laser energy adjust to the speed at which the operator moves which is around 0.5 cm per second, so each pass delivers the same energy , and usually apply 1 to 3 passes per treatment area.

Post treatment erythema , edema and petechiae and sometime pinpoint bleeding are usually resolved within one week to 10 days after the treatment , darkened crusts on the scar takeoff also with few days.

Soothing agents like calamine cream is applied 2 to 3 times per day post treatment and sometimes. Bepanthin cream which help to regeneration of epithelium especially when scars are peeled or thick crust is formed .The first visit after one week to two weeks. If erythema, crust, and edema subsided the second session was planned. The documented changes of the scars were taken. Massage of the scars was encouraged to help up the remove of the crust and resolve of the edema which is usually during the first week.

Results. Twenty one patients with twenty four scars completed the six month follow up visit after the final treatment by scanned CO₂ laser . Four patients (with 4 scar) did not continued the follow up and the remaining 17 patients completed the follow up of the study in average duration between 12-24 weeks.

The scars become soft, supple and smooth and obvious reduction of pain and tenderness after each session of the treatment as shown in table 1 and 2 and improvement of scar texture and consistency as shown in figure 1 and 2.

Post treatment immediate erythema was noted which usually continued between 5-7 days then subsided . four to six week after the second and third treatments erythema subside and become mild and by the end of the study nearly completely disappeared.

Edema was observed and peaked immediately after treatment , which also continue for 1 week and then resolved with time and massage in all patients , except in one patient with nose tip skin graft after excision of pigmented nevus continue after 6 months of the follow up.

Post procedure petechiae resolved in all by 5-7 days of the 3 treatments , no remaining petechiae after 6 wks follow up examinations. Those patients with darkened skin type IV skin , mild to moderate hyperpigmentation was noted after all 3 treatments but resolved nearly in all patient within duration of the study .Hypopigmentation was noted for a short duration in those patient with type II ,III skin types which improved without treatment. Crusting

Table 1: Shows the percentage improvement in patients scar pain and tenderness.

No. laser session	No. patient	Percent
1 st session	4	29.4
2 ^{ed}	10	58.8
3 ^{ed}	15	88.2

Table 2: Shows the percentage improvement in patients scar pain and consistency.

No. laser session	No. patient	Percent
1 st session	4	23.5
2 ^{ed}	8	47.24
3 ^{ed}	14	82



Figure 1: Shows the effect of pulsed CO₂ laser on surgical scar in the breast before (upper) and after (lower) its application

and pinpoint bleeding tend to resolved in first week of treatment except in those with abdomenoplasty scar which remained more than 10 days .No treatment induced scarring was observed Throughout the study period .No bacterial infections or episodes viral re activation occur.

Discussion. Wound scarring occurring after surgical procedures or trauma is a common cosmetic problem for patients. Atrophic scars, which present as topographical depressions, result when dermal collagen and connective tissue production during the physiologic wound-healing process inadequately compensate for the tissue loss present after injury. Wound tension, tissue apposition, individual variations in wound healing, and scar contraction are all factors that contribute to the creation of a depressed, atrophic

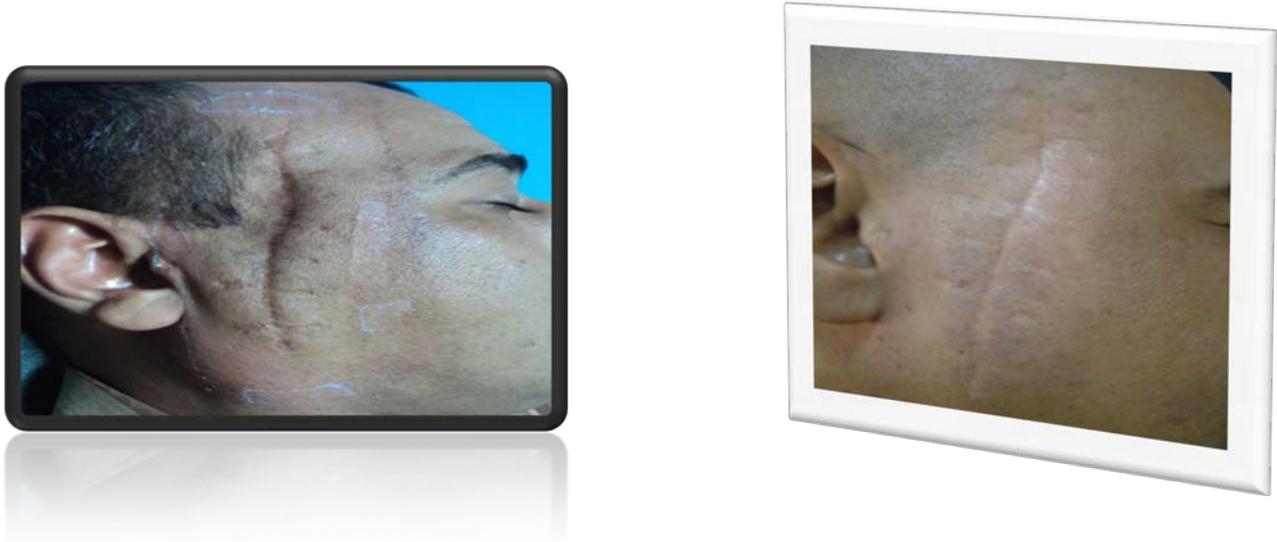


Figure 2: Surgical facial scar before (left) and after five sessions of pulsed CO₂ laser (right).

scar. With varying success, numerous ablative, non-ablative, and fractional devices have been used to stimulate neocollagenesis and dermal remodeling in an attempt to improve the appearance of atrophic scars and hypertrophic scar^{10,11}.

With non-ablative FP, despite the lack of tissue ablation, scarring can be moderately improved with a series of treatment sessions^{12, 13}. Combines CO₂ laser ablation with an FP system in a treatment known as ablative fractional resurfacing (AFR). A pixilated pattern of microscopic ablative wounds surrounded by healthy tissue is delivered to the skin¹⁴, and this combines the enhanced efficacy of tissue ablation with the shorter healing times and improved safety of FP technology. The AFR treatment avoids widespread epidermal coagulation while generating zones of tissue ablation and thermal coagulation much deeper than those seen with traditional ablative resurfacing. Deep zones of ablation and coagulation produce robust dermal remodeling, tissue tightening, neocollagenesis, and, ultimately, clinical improvement in atrophic scarring^{15, 16}.

Treatment with AFR was previously demonstrated to safely improve the appearance of atrophic surgical scarring by reducing the depth of individual scars^{17, 18}. In this prospective study, we evaluated the efficacy of AFR in the treatment of atrophic surgical and traumatic scars.

This impressive, uniform improvement across all scar variables is likely related to the ability of AFR to generate deep dermal ablation and coagulation to depths beyond those reached by traditional CO₂ laser resurfacing. Although not statistically significant, facial scars that were routinely treated at higher energy fluences (70 mJ per pulse) generally responded to a greater degree and had a more uniform response compared with off-face scars. This observation is likely related to the deeper levels of ablation and coagulation obtained with higher energy fluences. At higher fluences, tissue ablation and coagulation extend beyond 1 mm into the skin; this deep thermal effect may

produce more robust dermal remodeling and collagen production¹⁹.

During the 6-months follow-up, no incidents of delayed-onset hypopigmentation, Permanent pigmentary alteration, or scarring were observed. Treatments were well tolerated by patients, and adverse effects were generally mild to moderate. Compared with conventional CO₂ laser resurfacing, AFR treatments provided a safer adverse effect profile, a more rapid healing period, and shorter downtimes for patients^{20, 21}.

After traditional CO₂ laser resurfacing, delayed-onset hypopigmentation can be seen, however, no incidents of delayed pigmentary alterations were observed during our 6-month follow-up after the third treatment. From the date of the first treatment to the final 6-months follow-up, patients were followed up with no evidence of delayed pigmentary alteration. The preservation of healthy untreated skin between zones of thermal ablation likely explains the lack of delayed, permanent pigmentary problems after AFR treatment. Transient mild to moderate post-inflammatory hypopigmentation/hyperpigmentation developed in less than half of the AFR-treated scars, but these pigmentary changes all resolved spontaneously by 3 months after the final treatment.

The treatment protocol was based on our prior experience with non-ablative resurfacing and AFR treatments for acne scars. As we have observed previously, improvement follows the first treatment, and subsequent treatments lead to incremental improvements in scar appearance. Although treatment intervals varied from 1 to 4 months, patients generally reported that the oozing, crusting, and edema after the second and third treatments tended to be shorter and better tolerated¹⁶.

In conclusion, The ablation CO₂ laser treatment represent safe, effective treatment modality for improving scar quality, texture, maturation and appearance. The use of a CO₂ laser enables the creation of qualitative improvements and minimizes

patient down time and the risk of serious adverse effects , reported by patients and investigates in this study.

References:

1. Alster TS and Tanzi EL. Laser skin resurfacing: ablative and nonablative. In: Robinson J, Sengelman R, Siegel DM, Hanke CM, eds. *Surgery of the Skin*. New York, NY: Elsevier Science Inc; 2005:611-624.
2. Nanni CA and Alster TS. Complications of carbon dioxide laser resurfacing: an evaluation of 500 patients. *Dermatol Surg*. 1998;24(3):315-320.
3. Walia S and Alster TS. Prolonged clinical and histologic effects from CO2 laser resurfacing of atrophic acne scars. *Dermatol Surg*. 1999;25(12):926-930.
4. Geronemus RG. Fractional photothermolysis: current and future applications. *Lasers Surg Med*. 2006;38(3):169-176.
5. Manstein D, Herron GS, Sink RK, Tanner H and Anderson RR. Fractional photothermolysis: a new concept for cutaneous remodeling using microscopic patterns of thermal injury. *Lasers Surg Med*. 2004;34(5):426-438.
6. Sobanko JF and Alster TS. Laser Treatment for Improvement and Minimization of Facial Scars. *Facial Plast Surg Clin N Am*. 2011;19: 527-542
7. Laubach H, Chan HH, Rius F, et al. Skin responses to fractional photothermolysis. *Lasers Surg Med* 2006;38:142-9.
8. Fisher GH and Geronemus RG. Short-term side effects of fractional photothermolysis. *Dermatol Surg*. 2005;31(9, pt 2):1245-1249.
9. Graber EM, Tanzi EL and Alster TS. Side effects and complications of fractional laser photothermolysis: experience with 961 treatments. *Dermatol Surg*. 2008; 34(3):301-307.
10. Weiss E T, Chapas A, Brightman L, Hunzeker C, Hale E K, Karen J K, Bernstein L and Geronemus R G : Successful Treatment of Atrophic Postoperative and Traumatic Scarring With Carbon Dioxide Ablative Fractional Resurfacing. *Arch Dermatol*. 2010;146(2):133-140
11. Oliaei S, Nelson JS, Fitzpatrick R, Wong B, JF., Laser Treatment of Scars . *Facial Plast Surg* 2012;28:518-524.
12. Alster TS, Tanzi E and Lazarus M. The use of fractional laser photothermolysis for the treatment of atrophic scars. *Dermatol Surg*. 2007;33(3):295-299.
13. TIERNEY EP, KOUBA DJ and HANKE CW. Review of Fractional Photothermolysis: Treatment Indications and Efficacy. *Dermato ISurg* 2009;35:1445-1461.
14. Hantash BM, Bedi VP, Kapadia B. In vivo histological evaluation of a novel ablative fractional resurfacing device. *Lasers Surg Med*. 2007;39(2):96-107.
15. Vasily DB, Cerino ME, Ziselman EM. Nonablative fractional resurfacing of surgical and post-traumatic scars. *J Drugs Dermatol* 2009;8:998-1005.
16. Chapas AM, Brightman L, Sukal S. Successful treatment of acneiform scarring with CO2 ablative fractional resurfacing. *Lasers Surg Med*. 2008;40(6): 381-386.
17. Chapas AM, Brightman L, Sukal S. Successful treatment of acneiform scarring with CO2 ablative fractional resurfacing. *Lasers Surg Med*. 2008;40(6):381-386.
18. Waibel J, Beer K and Narurkar V. Preliminary observations on fractional ablative resurfacing devices: clinical impressions. *J Drugs Dermatol* 2009;8:481-5.
19. Hantash BM, Bedi VP, Chan KF and Zachary CB. Ex vivo histological characterization of a novel ablative fractional resurfacing device. *Lasers Surg Med*. 2007;39(2):87-95.
20. Fife DJ, Fitzpatrick RE and Zachary CB. Complications of fractional CO2 laser resurfacing: four cases. *Lasers Surg Med*. 2009;41(3):179-184.
21. Alster T, Zaulyanov L and Zaulyanov-Scanlon L. Laser scar revision: a review. *Dermatol Surg*. 2007;33(2):131 140