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Burn, Traumatic, Surgical scars treated by CO_2 Laser Therapy

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Abstract

Objective: Scar in the skin may occur after different events such as trauma, tumor resection, burn or with many surgical interventions. The main objective of this paper is to present the usefulness of CO_2 laser in the management of these scars. **Materials and Methods** : Questionnaire study among (240 cases) was performed after multi cessions of co2 laser resurfacing using Scanned carbon dioxide laser technique, the data collected depending on the patient self satisfaction about the results of the procedure and the final scar appearance. Each patient consider his satisfaction in a score (0---10). **Results:** According to our score of satisfaction, 214 patients (89.17%) of all cases given a score of (5 and above) were concluded as satisfied, and 26 patients (10.83%) given a complication rate was very low, (4.16%) of all cases. **Conclusion :** Scar management using co2 laser is consider as a very useful, less traumatic and successful procedure for scar revision and resurfacing with low complications rates.

Keywords: Scar, CO_2 laser, less traumatic.

Introduction

Advances in laser technology have allowed plastic surgeons to diminish the appearance of scars and wrinkles using both ablative and nonablative lasers. Until recently, surgeons relied on chemical peeling, dermabrasion, surgical scar revision, electrosurgical planning, and dermal/subdermal filler substances (e.g., collagen implantation, silicone injection, autologous fat transplantation) for the correction of scars and wrinkles. Today, physicians use 5 laser modalities for ablative skin resurfacing:

- Scanned carbon dioxide laser
- Pulsed carbon dioxide laser
- Pulsed Er:YAG laser
- Fractional Er:YAG laser resurfacing
- Combination carbon dioxide and Er:YAG lasers

Each of these treatments relies on the principles of selective photothermolysis in order to selectively target water-containing tissue and effect controlled tissue vaporization .Our method depend on Scanned carbon dioxide laser .

The carbon dioxide laser became available in 1964 and soon became the most widely used laser in dermatologic practice. The carbon dioxide laser emits an invisible infrared beam at a 10,600-nm wavelength, targeting both intracellular and extracellular water. When light energy is absorbed by water-containing tissue, skin vaporization occurs with production of coagulative necrosis in the remaining dermis .

Materials and methods

Patients treated by CO_2 laser therapy targeted by selected criteria to the therapy. 240 cases were treated using scanning co2 laser technique.

Patients' age range (9---55 years) with different areas involvements, male to female ratio are about (1 / 5), 45 M and 195 F.

The number of sessions given to each case range from three to nine depending on our and patient preference. Power used ranging from (4---6 W) depending on scar condition with each visit and the area involved. Local anesthesia was used in all cases (usually xylocaine spry 10%), [fig 3].

Every case asked about the satisfaction for the result of the laser therapy, and the degree of the benefits and the changes in the scar in multiple criteria (scar criteria).

Scar criteria

Shape: is important before the starting the laser therapy to take multiple pictures to the scar to make the comparison between the pre and post session changes.

***Edges*:** edge of the scar it's the land mark between normal and abnormal tissues. It's a good guider in recognition the improvement occurs after multiple sessions.

***Color*:** the color is the first criterion from the scar recognition like to be changed through the session.

***Thickness*:** which is the second criterion recognize to be changed in the improved scar.

The following criteria had been used in patients' selection:

- Adolescent & adult patient with realistic expectation of his or her condition.
- Surgical, traumatic or burn scar whether mature or not.
- All patients had scar with duration of one year or longer period.
- Also the following Cautions
- Patients out of the study include those with isotretinoin use within the previous 6 months, active cutaneous bacterial or viral infection in the area to be treated, and patient history of keloid formation or hypertrophic scarring.

The CO_2 laser machine used and its properties are show in the following figures, [fig 1, 2, 4]:

Fig (1): CO_2 laser machine

Laser type	Sealed off CO_2 laser
Wavelength	10.6 µm
Mode structure	TEM 00
Max output power	30W
Spot Size	0.2mm
Lens Focal Distance	100 mm / 50mm
Power Fluctuation	<= 10%
Aiming Beam	630nm Red Laser (adjustable brightness)
Delivery System	Articulated Arm With Scanner
Operation Mode	Continuous Wave , Single Pulse , Repetition Pulse , Super Pulse , Scanning
Scanning Pattern	Circle , Triangle, Rectangle, Line
Scanning Size (max)	20 mm x 20 mm
Pulse Width	Single Pulse (0.01-1s) Repetition Pulse (0.001-1s) Super Pulse (0.01-1s) Scanning (100µs-10 ms)
Cooling System	Internal Closed –loop Water Cooling Circulation
Power Supply	100~120VAC ,50/60Hz or 200~240 VAC , 50/60 Hz
Input Power	500 VA
Environment Temperature	5-40° C
Relative Humidity	≤ 80%
Dimension (W*L*H)	260mm X 360mm x 960mm
Weight	46 kg

Fig (2): Device properties

Fig (3): Local anaesthesia

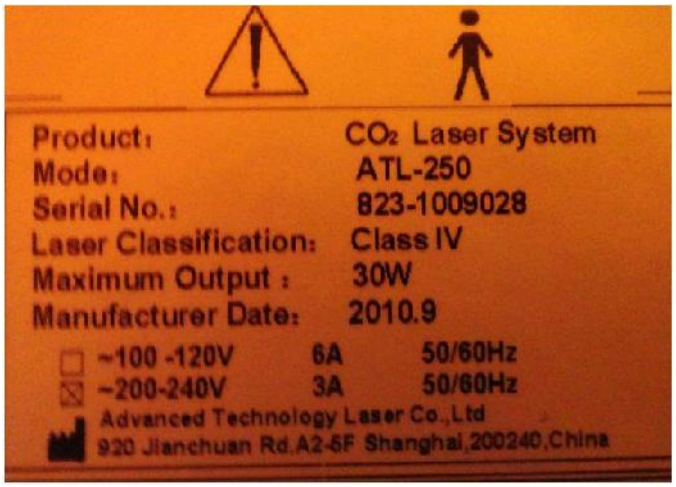

Fig (4): Manufacture label

Results

All the 240 cases were asked about their satisfaction in a score of (0-10) and the following results obtained:

- Number of patients who are satisfied which are (those above 5) in score was 214 which mean 89.17% of all cases.
- Patients who are score (7& above) which considered as very good was 197 which mean 82.08% of all cases.
- Number of non satisfied patients (4& less) was 26 cases which mean 10.38% of all cases.
- Those with non-satisfied results (26) cases:
- (10) Of them had poor compliance regarding attending procedure at exact time of our schedule.
- (16) Of them had poor compliance regarding pre and post procedure management.
- No major differences were observed regarding the area of management.
-

The following table [tab 1] represents the results:

Table (1): Results

Degree of satisfaction	0	1	2	3	4	5	6	7	8	9	10	total
Number of patients	-	-	1	12	13	9	8	15	85	75	32	240
percentage	0%	0%	0.44%	5%	5.4%	3.75%	3.3%	6.2%	35.4%	31.2%	13.3%	100%

Complications were very low and include the following:

3 patients developed hyperpigmentation, 1 patient developed hypopigmentation, and 5 patients developed prolong erythema > 21 days,

1 patient developed thinning of skin. This represents 10 cases (4.16%) of all.

Case no 1:

17 years old female with depressed and pigmented scar in the left cheek for 7 years duration [fig: 5], four sessions later [fig: 6]

Fig (5): Pre procedure

Fig (6): Post procedure

Case no 2:

30 years old male with depressed scar in the right cheek for 5 years duration [fig: 7], five sessions later [fig: 8]

Fig (7): Pre procedure

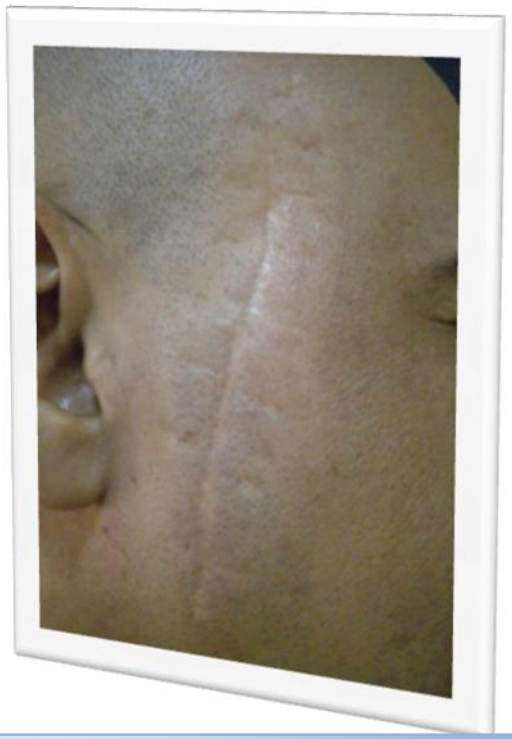

Fig (8): Post procedure

Case no 3:

27 years old female with hyper pigmented trauma scar to the right leg [fig: 9], four sessions later [fig: 10]

Fig (9): Pre procedure

Fig (10): Post procedure

Case no 4:

20 years old female with burn scar to the face [fig: 11], five sessions post procedure [fig: 12]

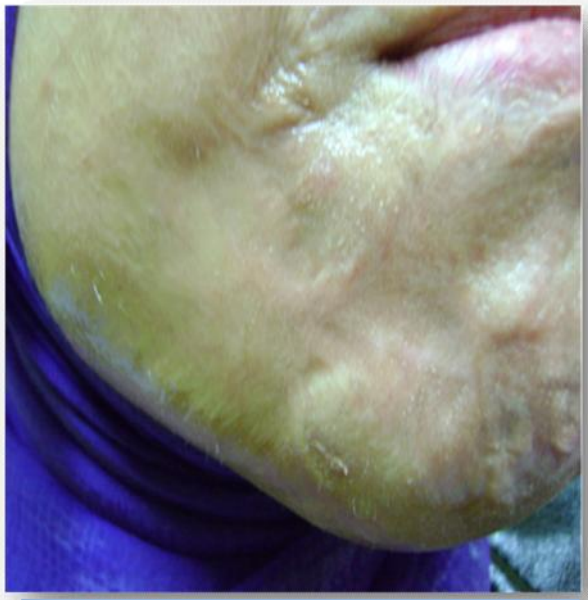

Fig (11): pre procedure

Fig (12): post procedure

Discussion

Tissue vaporization is best accomplished with minimal coagulation or residual thermal damage when exposure times are shorter than 1 millisecond. In addition, 5 J/cm 2of energy is needed to exceed the vaporization threshold of the targeted skin.

Two different carbon dioxide laser technologies can deliver sufficient energy to vaporize the skin in less than 1 millisecond. One involves the use of an ultra-short pulse to deliver the energy to tissue. The second (as we used in our study) uses a computer-controlled optomechanical shutter system, which scans a continuous wave beam so rapidly that the emitted light is prevented from contacting skin for more than 1 millisecond .

Several factors contribute to the fact that uniform laser parameters in clinical practice do not exist. So varying styles of laser practice between surgeons could affect end clinical results.

We used our parameters according to skin condition in each visit. In addition to the laser parameters chosen, for example, clinical effect is also influenced by the number of laser passes delivered, the degree of scan overlap, the complete/incomplete removal of partially desiccated tissue between each laser pass, preoperative preparation, and postoperative wound care.

Our results show that success rate in improvement of scar appearance which is 89.17% may indicate that CO_2 laser is a good method of management of scar.

This is supported by the overall results and by the low percentage of complications (4.16%).The majority of patients had very good results 82.08% (those 7 and above) [fig 13].

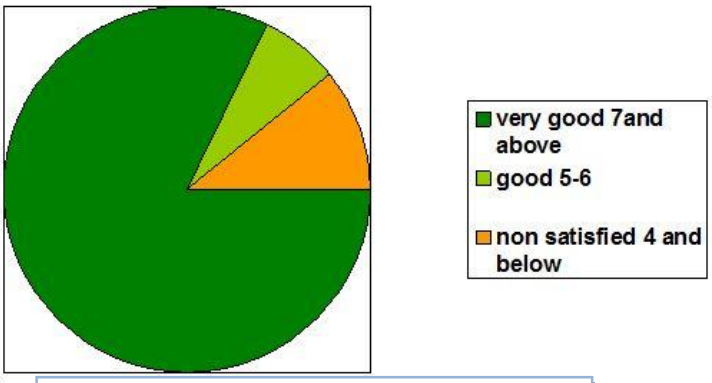

Fig (13): Percentage of patient satisfaction

Patient's compliance regarding the procedure (pre- and post) is greatly affecting the outcome as almost all the non- satisfied patients have poor compliance.

Our impression about improvement my not correlate with patients' one, but we depend on their answers as it the aim of the study.

Major limitation in our practice was those patients below the age of 12 years, as its non-comfortable procedure to them under local anaesthesia and obtaining their satisfaction was very difficult so we ask the parents about their satisfaction.

The effects of intraoperative heat-induced contraction, whether due to thermal desiccation or true collagen shrinkage, are known to be temporary, lasting approximately 14 days after surgery.

However, the immediate shrinkage may exert an indirect long-term effect by providing an initial matrix for the deposition of new collagen, which permanently recapitulates the shortened fiber.

The improvement secondary to CO_2 laser skin resurfacing of the quality, texture, elasticity, and turgor of the skin cannot be explained by the shrinkage of collagen alone. It is the neocollagenesis and neoelastogenesis that can explain the significant improvement after CO_2 laser resurfacing.

It is clearly demonstrated neocollagenesis and Neoelastogenesis at 6 weeks and increased density and organization at 6 months and 1 year.

Progressive aesthetic improvement for as long as 18 months after procedure may be seen. Further development in our work may include the usage of general anaesthesia, especially in children

Conclusion

Scar management using CO_2 laser is consider as a very useful , less traumatic and successful procedure for scar revision especially if it is done by well trained surgeons and medical members to ensure amazing results with low complications rates.

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