

Retrospective Study on Clinical Effect of Fractional CO₂ Laser in the Treatment of Post Burn Scar Among Patients in Sultan Qaboos University Hospital, Dermatology Clinic

Tarik Sulaiman Al-Nasseri*

Graduating Resident, Dermatology Training Program, Oman Medical Specialty Board, Muscat, Oman

*Corresponding Author: Tarik Sulaiman Al-Nasseri, Graduating Resident, Dermatology Training Program, Oman Medical Specialty Board, Muscat, Oman.

Received: December 17, 2019

Published: January 20, 2020

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Abstract

Background: Scars are abnormal wound responses in predisposed individuals. Most of post burn scars result in aesthetically disabling and some of them may cause functional disability. Although several approaches have been tried in their management, most of them have produced poor results. The introduction of fractional CO₂ lasers shows promising results in treating burn scars with fewer side effects. Whilst recent studies have focused on objective scar outcomes following fractional CO₂ laser, few data on patient subjective factors such as quality of life are available.

Objective: This study aims to analyse the efficacy of fractional CO₂ laser as a treatment for post burn scars from patient point of view and the degree of their satisfaction with this method of scar treatment.

Methods: We performed a retrospective study of 26 patients (18 females, 8 males) who underwent fractional CO₂ laser procedures for treatment of burn scars at dermatology clinic of Sultan Qaboos University Hospital, period from January 2017 to April 2018. Variants collected were age, gender, skin type, age of burn scar, site of scar, number of laser sessions finished and complications that occurred during or after the treatment sessions. All scars were assessed by the patients themselves through the Patient and Observer Scar Assessment Score (POSAS) form. This score assesses six variants (before and after laser sessions) including pruritus, pain, colour, pliability, thickness and relief. Each scored numerically on a ten-step scale (maximal 60). Beside that patients were asked to give overall opinion i.e, how much improvement after got treated with laser (maximal 10) compared to pre-laser treatment.) Figure 1 A Wilcoxon Signed-Ranks Test was used to compare pre and post laser treatment to assess the effectiveness of the laser.



Figure 1: Fractional CO₂ laser machine used in the clinic.

Results: A Wilcoxon Signed-Ranks test indicated that the median post-treatment POSAS-P scores 14.0, were statistically significantly lower than the median pre-treatment POSAS-P scores 35.5, ($Z = -4.46$, $p < .001$). The overall POSAS-P scale reported significant drop from a median of 9 to 3 ($Z = -4.48$, $p < .001$). Colour of the scar showed best response compared to other variants. Among all patients treated only three patients got scarring and two patients had transient edema post laser treatment.

Conclusion: Fractional CO₂ laser use is an effective and safe method for treating burn scars with a significant change in the opinion of the patients about their scar appearance and symptoms.

Keywords: Post Burn Scar; Fractional CO₂ Laser

Introduction

Cutaneous scarring remains the pathognomonic feature following burns to the skin and characteristically underlies post-burn physical and psychosocial morbidity. The most common cicatrix formed following a burn is the hypertrophic scar, the prevalence of which has been reported as being as high as 70% [1]. It's usually described as red, firm, raised, and remain confined within the original area of the wound. On a molecular level, hypertrophic scars result from disorganized and excessive collagen deposition through abnormalities in the wound healing phases of inflammation, proliferation, and remodelling [2]. They tend to form early after the inciting injury, often within the first 2 to 4 months and slowly improve over the course of 6 to 9 months after that point few changes are observed [3].

Although burn scars show the most disfiguring secondary effects in clinical practice, only few treatments are available to improve the appearance and texture of these scars today. Standard treatments for burn scars include scar revision, compression therapy, tissue expansion, intralesional steroid injection, interferon injection, and laser treatment [4,5].

Several lasers and light sources have been evaluated in the past decades and have been shown to improve scars [6]. Lasers employed for resurfacing of scars are divided into ablative and non-ablative lasers. Laser resurfacing is supposed to work by stimulating collagen production in the dermis and by dermal remodelling of collagen fibers [7].

Conventional ablative lasers, particularly conventional erbium-doped yttrium aluminium garnet laser, erbium YAG (Er: YAG) and conventional CO₂ lasers have been proven to be very effective in scar treatment by ablating the bulk of the tissue and inducing collagen remodelling and regenerative mechanisms. However, the associated side effects and prolonged recovery period can limit patient satisfaction with these devices [8].

With the introduction of fractional photo thermolysis (FP), fractional ablative lasers have combined the impressive results of ablative lasers with the low side effects profile of non-ablative lasers [8]. Fractional photo thermolysis introduced by Manstein and Anderson in 2004 offers the possibility of a more successful, and possibly cost-effective way of managing these difficult patients by manipulating the scar rather than excising it. The term 'fractional' is used as the technique produces thousands of narrow, non-contiguous columns of thermal damage called microthermal zones (MTZs) in the skin which are separated by healthy, untreated skin with an intact epidermis. This allows the treating physicians to go for much deeper treatment (up to a depth of 4 mm of the skin and scar tissue) than with traditional laser resurfacing; the amount of epithelial loss is confined to the narrow diameter of the column allowing rapid re-epithelization, i.e. healing. Additionally, the adverse effects encountered with FP are transient and less se-

vere than with full skin resurfacing. Fractional CO₂ laser resurfacing has been successfully used in the treatment of atrophic acne scars, rhytides and photo aged skin. There are also some reports of its usefulness in hypertrophic as well as burn scars [7]. In addition fractional ablative CO₂ lasers are considered superior to fractional non-ablative lasers due to their ability to release contracted scars and their unique chemical pathways that contribute to proper healing [8].

The aim of this present study was to assess the efficacy of fractional ablative CO₂ lasers in the treatment of post burn scars through assessing the patient's satisfaction after getting treated with laser.

Methods

This retrospective cohort study was approved by the SQUH research Ethical committee, Muscat, Oman and informed consent forms were signed by enrolled subjects.

Twenty six patients (18 females, 8 males aged 5 - 48 years) with skin photo types III to V and burn scars at different body sites received from 3 to 30 sessions of fractional CO₂ laser treatments in a period from January 2017 to April 2018, with an average of 5 weeks interval, A single physician performed all the laser sessions. Patients with keloidal tendency, patients with concomitant skin disease at the site of treatment, use of isotretinoin in the past 6 months and pregnant or lactating females were excluded.

After an informed written consent for laser resurfacing, a baseline photograph of the scar to be treated was taken using standard camera angle and light settings. After cleansing, topical anaesthetic EMLA cream (lidocaine 2.5% and prilocaine 2.5%) was applied to the target area 30 - 60 minutes before the procedure, and then the area was washed off and properly dried before laser application. The CO₂ laser machine used is Lumenis (Figure 2), the following parameters were used in a single pass (in all cases) : power: 10 watts, energy: 150 mj/cm, density setting: 5%, spot size and pattern depend on the scar size and shape, Laser pulses were placed adjacent to one another without overlapping, thereby preventing new scar formation. Patients were instructed to avoid the sun and cosmetics during the immediate post procedural periods and to apply cool compresses, emollient creams and sunscreens until complete re-epithelization. A topical antibiotic was prescribed after the procedure for a period of 1 week then to use Hirudoid cream for 1 month. At each follow-up visit, the scar was photographed and assessed.

Patient's assessment of their scars was obtained by distributing POSAS-patient assessment questionnaire (Figure 3-5) to the attending patients. It contains six questions applying to pain, itching, colour, pliability, thickness and relief. Each of the six items on both scales has a 10-point score, with 10 indicating the worst imaginable scar or sensation. The lowest score is '1', and corresponds to the situation of normal skin (normal pigmentation, no itching etc),

Figure 2: Patient and Observer Scar Assessment Scale (POSAS)- patient assessment form.

and goes up to the worst imaginable. These six items add up to the Total Score of the Patient Scale. The Total Score will therefore range from 6 to 60. Patients were asked to evaluate each variable before and after laser treatment sessions. Besides those six questions, the patient is asked to provide an overall opinion concerning scar quality. (www.posas.org).

Figure 3: POSAS - Patient assessment scale in Arabic.



Figure 4: 26 years old patient with burn scar on dorsal hand- before laser.



Figure 5: Same patient after 3 sessions of laser.

All data were collected and transferred to Microsoft Office Excel. The statistical analysis was performed using statics Package for the Social Sciences software (IBM SPSS statistics, version 22). A Wilcoxon Signed-Ranks test was used to compare the results before and after the laser treatment of POSAS-P, overall POSAP-P and other variants.

Results

In our study, there were 18 females and 8 males (F:M ratio of 2.25:1), with age ranging from 5 to 48 years with a mean of 22.5 years. Almost 75% of the patients were under 25 years old. Majority of our patients belonged to Fitzpatrick Skin type IV (14 patients) and skin type III (11 patients), one patient only with skin type V. Age of the scars (time from burn till they fill the assessment form) ranged from 1 year to 28 years, with a mean of 10 years old. Number of laser sessions received varied from 3 up to 30 sessions with a mean of 9 sessions.

Almost all the burn scars treated were of hypertrophic type and were due to either flame or scald burns. Treated burn scars were located on the face in 12 patients (46.2%), upper limbs in 8 patients (30.8%), Lower limb in 3 patients (11.5%) and the abdomen in 3 patients (11.5%). Previous treatment modalities received were intralesional steroids, grafting and topical treatments.

A Wilcoxon Signed-Ranks test showed that patient score of the POSAS (POSAS-P, maximal score 60) dropped significantly from a median of 35 (IQR 25 – 49) before laser treatment to a median of 14 (IQR 7 - 34, Z= -4.46, p < 0.001) following treatment with fractional CO₂ laser. Equally, the overall POSAS-P score (maximal score 10) improved by 6 points from 9 (IQR 6 – 10) to 3 (IQR 1- 7, Z= 4.48, p < 0.001).

Among the variables assessed the color of the scar showed the best response with Z value of -4.48, higher than the other variables. This followed by pliability and thickness with a Z value of 4.40 and 4.39 consecutively. Pain is the least that patient think that changed (Table2).

	POSAS_P (0 – 60)	POSAS_P (0 – 10)
Pre-treatment score	35.5 (25 – 49)	9.0 (6 – 10)
Post-treatment score	14.0 (7 – 34)	3.0 (1 – 7)
Z value of Wilcoxon Rank Test	- 4.46	- 4.48
P value	< 0.001	< 0.001

Table 1: Comparison of POSAS outcome parameters (Scores reported as a median with interquartile range IQR unless denoted otherwise).

Patients tolerated the procedure well and just 19% patients experienced mild pain during treatment. Other side effects noticed by the participants were edema in two patients (7.7%) in the first week after laser treatment which was resolved with cold compresses and head elevation. Also, as long-term side effects “scarring” was noticed in 3 patients (11.5%).

	Pain	Pruritus	Color	Pliability	Thickness	Relief
Pre-treatment	1.0 (1 - 9)	2.5(1-10)	9.0(5-10)	7.5 (3 - 10)	8.0(3-10)	8.0(1- 10)
Post- treatment	1.0 (1 - 3)	1.0 (1 - 5)	3.0 (1 - 7)	3.0 (1 - 10)	3.0 (1 - 8)	2.5 (1 - 9)
Z value of Wilcoxon Rank Test	-3.068	-3.644	-4.474	-4.396	-4.385	-4.298
P value	.002	.000	.000	.000	.000	.000

Table 2: Comparison of POSAS-P variants before and after treatment (Scores reported as a median with interquartile range IQR unless denoted otherwise).

Discussion

Ablative Fractional CO₂ laser has recently been introduced for burn scar treatment because of its notable clinical outcomes and fewer side effects. Objective measures showed significant improvement of the burn scars following fractional CO₂ laser treatment and a significant change in the opinion of the patients about their scar appearance. This was in agreement with the findings of several researches using different parameters [4,6,7].

Various scoring systems have been utilized in assessing the severity of burn scars and their response to treatment such as the Vancouver Scar Scale (VSS), Manchester Scar Scale and Patient and Observer Assessment Scale (POSAS) [6]. In our clinical study, we used POSAS scoring system as we want to analyse the patient assessment of their own scar before and after laser treatment, as some of the variants such as pain and pruritus -which is important measures for quality of life- not included in other scoring systems.

Most of our patients were females (around 70%), probably due to higher concern about cosmetic appearance, or maybe because most of the burns has occurred while cooking at kitchen with females being frequently there. Most of our patients were young with a mean of 22 years old and that’s because most of the patients of SQU Hospital are of this age group (university students). Different patients receive different number of laser session treatments according to their response but settings of the laser- mentioned at methods previously- almost the same for all the patients with single physician who did the laser and a mean interval of 5 weeks between the treatment sessions. Treatment sessions varied from 3 up to 30 sessions for burn scars at different sites of body with different scar ages. As per previous studies usually older scar age have slow response to laser treatment and it will need many sessions till it gives a good results [8].

In the present analysis, we demonstrated a significant improvement in a patient score of the POSAS after laser treatment compared to before. In comparison to previous study, Issler-Fisher, et al. give similar effects with drop in POSAS patient scale and in the overall opinion. Also, it showed significant reduction in pain and pruritus. Levi, et al. also concluded that overall patient satisfaction with laser therapy was 96.7% and patients reported reduction in neuropathic pain, pruritus and tightness [3,9,10].

All of the variants assessed showed significant improvements after laser therapy in patients’ opinion with color of the lesion followed by pliability noted that have a remarkable changes than others. Pain showed the least response because some of the patients maybe thought it’s the pain that felt during or immediately after laser therapy, although it’s explained well to the patients that pain of neuropathic persistent type is what was meant in the questionnaire. The assessment form was translated to clear Arabic language to make it easier to answer.

Mild pain was observed in five patients (19%), which was in the first 24 hr after laser treatment. It’s mostly seen in patients with first sessions and with children, but in the subsequent sessions patients usually get used to the usual laser pain. Two patients developed transient swelling (edema) at the site of laser therapy. This is common and varies from one person to another. Most patients will swell mildly, but in some patients the swelling is more severe. Usually cold compresses and head elevation reduced that. Although most of laser complications can be mild and treated easily some of them can be severe. Scarring is the most common example which usually occurs because of some secondary factor that interferes with healing, such as infection, irritation, scratching, or poor wound care. Some of them result from parameter mis usage in the form of excessive fluence or density, too many passes or pulse

stacking. Most of the scars disappear in a few months, but some scarring may be permanent. Generally, the developed side effects did not affect patient's satisfaction with the achieved results as indicated by significant reduction in POSAS patient's overall assessment scores.

Our study was subjected to several limitations. The most notable limitation being a non- prospective study design and thus the absence of a control group in which no laser treatment was performed. A further limitation of this study is that we have relied completely on patient self-assessment to give their opinion before and after treatment. This will get affected by their emotions about the improvement in their condition after laser therapy, which is not accurate way to assess the efficacy of treatment. One way to address many of these limitations would be to perform a randomized, controlled trial with a pre- treatment and post-treatment questionnaire and standardized photographs with scored objective assessment. This would improve our ability to accurately assess the direct benefits of this technology. However, in our study our aim is more of analysing how much the patients receiving the laser treatment are satisfied and how much the quality of their life improved after got treated.

Conclusions

This study strongly supports previous reports that burn scars can be dramatically improved in various domains by using fractional CO₂ laser including pain, pruritus and appearance of the scar. It achieves significant change in the opinion of the patients about their scar appearance and improvement in the quality of their life. It demonstrates that this method of treatment is a safe and effective method of treating burn scars.

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