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Efficacy of Fractional CO_2 Laser in Atrophic Acne Scars

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Abstract

Background: Laser surgery is not just an effective treatment for acne scars, but is also easier to use than other treatment modalities. Different types of laser modalities, such as non-ablative and ablative lasers, are effective in treating atrophic acne scars, except for the deep ice-pick scars.

Aim: The present study was aimed at evaluating the efficacy and the safety of fractional carbon dioxide (CO2) laser in treatment of facial atrophic acne scars along with the consequential change in the quality of life of such patients.

Material and Methods: The study was a hospital based prospective observational study where 30 adults (aged 18 or above) patients diagnosed with atrophic acne scars children attending dermatology OPD at a tertiary care teaching hospital in Mumbai were included in the study and treated with fractional CO_2 laser. Acne scar grading of the patients was done on the basis of Goodman and Baron qualitative as well as quantitative scale and echelled'evaluationclinique des cicatrices d'acne (ECCA) grading scale for acne scars.

Results: The mean Goodman and Baron score before treatment was 24.97±9.90. But after treatment it was significantly decreased to 15.46±6.37. After the treatment, erythema (53%) and edema (47%) were observed as most common immediate side effects of the treatment.

Conclusion: Fractional CO_2 laser treatment has contributed significantly not just in improving the clinical appearance and other parameters of the treatment areas but also in enhancing the quality of their life of these affected patients.

Keywords: Fractional CO_2 Laser; Facial Atrophic Acne; Goodman and Baron Score; Quality of Life

Abbreviations

MTZs: Microscopic Thermal Zones; EMLA: Eutectic Mixture of Local Anaesthetics; DLQI: Dermatology Life Quality Index.

Introduction

Acne scars result from permanent changes to the epidermis, dermis, and subcutaneous tissue. Following the initial injury, tissue undergoes three stages of wound healing - inflammation, granulation, and tissue remodelling [1]. Acne scars are classified as atrophic or hypertrophic, and their clinical appearance is summarized in this paper [2].

Laser surgery is not just an effective treatment for acne scars, but is also easier to use than other treatment modalities. Different types of laser modalities, such as non-ablative and ablative lasers, are effective in treating atrophic acne scars,

except for the deep ice-pick scars. Laser treatment stimulates the fibroblasts to replace the lost dermal components of the collagen and elastin, thereby filling up the scar defect [3].

Although conventional ablative laser is an effective treatment for skin resurfacing, yet its widespread use is limited due to prolonged downtime and complications such as bleeding, edema, infection, scarring, dyspigmentation and line of demarcation. On the contrary, the side-effect profile of non-ablative resurfacing is significantly decreased due to absence of epidermal damage. However, the fact is that non-ablative lasers produce fewer effective results than conventional ablative lasers [4]. Recently, fractional ablative technology is found to have overcome the higher side-effect profile of the conventional ablative lasers and even shortened the down-time, while still achieving significant clinical outcome that is comparable with conventional ablative lasers [5].

Fractional ablative lasers create microscopic columns of thermal injury, namely, microscopic thermal zones (MTZs) in the epidermis and dermis and stimulate the wound-healing response [6]. These columns are stated to comprise approximately 15 to 82% of the skin surface area per treatment session. However, depending on the preferred laser parameters and number of passes, the percentage of the thermally ablated tissue may be substantially widened [7].

Despite numerous studies evaluating fractional ablative lasers for acne scars, there remains a paucity of real-world evidence focusing on Indian skin types (Fitzpatrick III–V) and the correlation with quality-of-life outcomes. This study addresses this gap by evaluating both clinical efficacy and psychosocial impact using standardized scoring and DLQI.

Materials and Methods

Study Design, Settings and Participants

It was a hospital based prospective observational study conducted over a period of one year from October 2021 to September 2022 in Department of Dermatology, Venereology and Leprosy, D.Y. Patil University School of Medicine, Nerul, Navi Mumbai, India.

Adult patients age 18 years and above who were diagnosed with atrophic acne scars constituted the study population. Patients with tendency to form hypertrophic scars/keloids, suffering from blood coagulability disorders, patients with ongoing anti-thrombosis treatment, known cases of Collagen Vascular Disorders, pregnant/breastfeeding women and patients with photosensitivity were excluded from the analysis. Total 30 patients were finally included in the study after considering inclusion and exclusion criteria.

Data Collection

Informed consent was taken from all patients who satisfy the inclusion criteria. An information sheet was given to all participating patients. At the time of enrolment, a detailed history was taken and a thorough clinical examination was done.

The findings were recorded in a predesigned proforma. Clinical photographs of the patient's face were taken from a distance of 1-1.5 feet from the following angles- Left profile, Right profile and Frontal profile. Background characteristics including previous medication taken for the treatment of acne and acne scars, family history, occupational history, known history of blood coagulability disorders, history of tendency to keloid/hypertrophic scars, history of truncal acne, history of picking on acne lesions, history of comorbidities and treatment taken for the same, pregnancy in past or ongoing pregnancy and menstrual history was noted.

Acne scar grading of the patients was done on the basis of Goodman and Baron qualitative as well as quantitative scale and echelled'evaluationclinique des cicatrices d'acne (ECCA) grading scale for acne scars, which consists of 6 items designed to assess easily and quickly the severity of acne scars by a global score.

Fractional CO_2 Procedure

Procedure was performed in the Laser Clinic after complying with the following aseptic precautions:

- Site to be treated was cleaned thoroughly with betadine and then wiped with normal saline.
- Topical anesthesia in the form of Eutectic Mixture of Local Anesthetics (EMLA) cream (containing 2.5% each of Lidocaine and Prilocaine) was applied to the area to be treated, under occlusion using a micropore tape for 45 minutes.
- The fractional CO_2 laser machine was set in a desired mode and the parameters was set to a moderate to high density of MTZ/cm^2 along with high energy settings in a small square or circular geometrical pattern (so as to match the shape of the base of the scar and to suit all the scars in general). Skin surface to be treated is then stretched and the base of the individual atrophic scars is laser impacted once or twice depending on its morphology (one to two passes per session). All the scars are then treated, one by one in a similar manner.
- Patient was, thereafter, be instructed to apply topical Fusidic acid cream on the sites where laser is delivered, twice daily; and to avoid washing the face with soap for

the next 24 hours. If required, washing the face with cold water is acceptable, as it also relieves any facial soreness felt after the procedure.

- Adequate sun protection in the form of topical sunscreen creams (every four hours during daytime) was advised.
- A total of three treatment sessions were delivered to the patient, with a gap of three weeks between each treatment.
- Patients were asked to follow up after a duration of 6 months after their third laser treatment session to assess the final outcome.

Dermatology Life Quality Index (DLQI) of the patient was assessed before the procedure. DLQI was based on a 10-question questionnaire to measure the impact the skin disease has on the quality of life of the patient [8].

Statistical Analysis

Data were analyzed and statistically evaluated using SPSS software, version 17 (Chicago II, USA) [9]. Quantitative data was expressed in mean, standard deviation and difference between pre post groups were tested by Wilcoxon signed rank test while qualitative data were expressed in percentage and pre post comparison were tested by McNemar Test. 'P' value less than 0.05 was considered statistically significant.

Ethical Issues

All caregivers were explained about the purpose of the study. Confidentiality was assured to them along with informed written consent. The study was approved by the Institutional Ethical Committee.

Observation & Results

The present study enrolled 30 patients (M:17; F:13) with a mean age of 28.36±4.54 years and ranged from 22 to 41 years. The majority of patients (70%) had a score of 4 (21 patients) followed by 20% of patients had a score of 3 (6 patients) and 10% of patients had a score of 3 on Fitzpatrick skin score.

Acne scar grading of the patients was done based on echelle d'evaluation clinique des cicatrices d'acne (ECCA) grading scale for acne scars and found that almost all the study patients had the severity of acne scars.

The mean Goodman and Baron score before treatment was 24.97±9.90. But after treatment it was significantly decreased to 15.46±6.37. Before treatment, 3 patients had macular, but after treatment 16 patients were improved and grouped in macular. In mild atrophy category only one patient improved after treatment.

Before treatment 7 patients showed moderate atrophy but after treatment 5 patients improved and 2 patients remains in the group. Severe atrophy was observed in 9 patients before treatment, but after treatment, none of the patients were in severe atrophy. All patients were improved (Tables 1 & 2).

Parameters	Before Treatment	After Treatment	P value
Goodman and Baron Score-Quantitative	24.97±9.90	15.46±6.37	<0.0001
Macular	3	16	<0.001
Mild atrophy	11	12	
Moderate atrophy	7	2	
Severe atrophy	9	0	

Table 1: Comparison of Goodman and Baron Quantitative Score before and after treatment.

Scar Type	No. of Patients	Improvement Observed	Comments
Rolling	22	Marked (>50%)	Best response
Boxcar	18	Moderate (30–50%)	Variable outcome
Icepick	10	Mild (<30%)	Least responsive

Table 2: Summary of Acne Scar Types and Response to CO_2 Laser.

Mean Dermatology Life Quality Index (DLQI) score before treatment was 18.67±5.04 which was improved significantly to 10.67±2.53 after treatment with fractional CO_2 laser (Figures 1-4).

Figure 1(A&B): Rolling and boxcar acne scars in a 35-year-old male patient before and after three sessions of fractional resurfacing using 25 mJ with a density of 15%, showing moderate improvement; (A) right cheek, baseline; (B) right cheek, post treatment.

Figure 2(A&B): Rolling, icepick and boxcar acne scars in a 29-year-old male patient before and after three sessions of fractional resurfacing using 25 mJ with a density of 15%, showing mild to moderate improvement; (A) right cheek, baseline; (B) right cheek, post treatment.

Figure 3(A&B): Rolling and boxcar acne scars in a 26-year-old male patient before and after three sessions of fractional resurfacing using 25 mJ with a density of 15%, showing moderate improvement; (A) right cheek, baseline; (B) right cheek, post treatment.

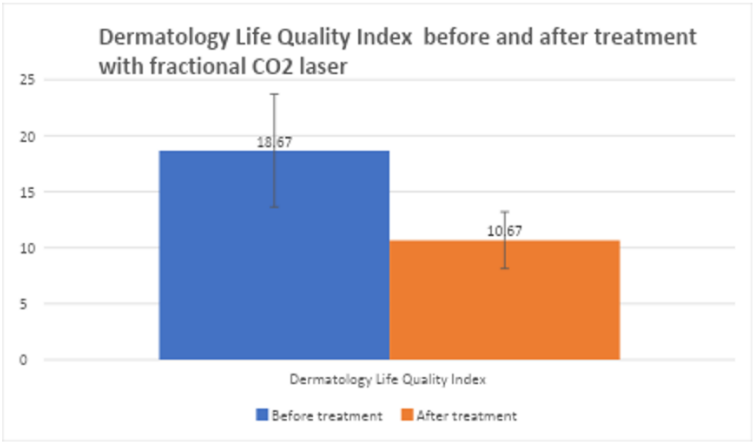

Figure 4: Dermatology Life Quality Index before and after treatment with fractional CO_2 laser.

After the treatment, erythema (53%) and edema (47%) were observed as most common immediate side effects of the treatment. The other side effects due to the treatments were post inflammatory hyperpigmentation (53%) followed by milia (27%) and purpura/ecchymoses (20%).

Discussion

In the treatment of patients who have acne scars, the purpose of this study is to evaluate both the effectiveness and the safety of using a fractional CO_2 laser. In this study, there were a greater number of male participants than female participants who had post-acne atrophic scars. Because acne affects young men more severely than it does young women, acne may have left serious scars on the faces of young men [9]. Concerning the characteristics of patients, a recent systematic review was carried out, and the total number of patients in all the studies that were included was 288 patients. There were 144 patients in the CO_2-laser group, and 144 patients in the non-CO_2-laser group, and their average follow-up time was (6.3) months. The average age of every patient (non-gender wise) was (28.1 years) [10]. The participants in this study had a mean age of 28.36 years old, which is consistent with the findings of the prior study.

In this study, usage of energy (12–20 J/cm^2) and treatment density (150–200 MTZ/cm^2) was determined based on scar morphology and patient skin types (predominantly Fitzpatrick type III–IV). Higher fluences were preferred for deeper rolling and boxcar scars, while uniform passes ensured consistent ablation depth across irregular surfaces. Adjustments were made depending on lesion response and patient tolerance during each session.

The researchers Kim CNT, et al. [12] utilized a procedure called fractional radiofrequency micro- needling on 52 patients who had atrophic acne scars on their faces. According to the grading system, 73.1% of patients showed signs of improvement overall. Using the grading system, we found that more than ninety percent of the patients had improved during this study. After the inflammation cleared up, five patients developed post-inflammatory hyperpigmentation. In contrast, the current study included 16 patients who had previous experience with PIH, accounting for 53.3% of the total. The authors concluded that this procedure is useful and carries a low chance of experiencing difficulties [12]. Chandrashekar BS, et al. [13] successfully treated 31 patients whose acne scars ranged from moderate to severe by using a technique called microneedle radiofrequency and reported that as per Goodman and Baron's Global Acne Scarring System, 80.64 percent of grade 3 and 4 acne scars improved by two grades, while 19.35 percent improved by one grade throughout treatment. The same kind of observation was noticed in both the previous study and the current one.

The patients claimed that they experienced pain, erythema, edema, and hyperpigmentation as temporary adverse effects of the treatment [14]. Edema, erythema, and PIH were also found in the current investigation, which is consistent with the findings of the prior study. Elawar et al. recruited 19 patients to assess the improvement in acne scars and skin, as well as the reduction in skin pores, that occurred as a result of receiving between two and four micro- needling fractional radiofrequency treatments at monthly intervals. Our observation revealed that early application of coolants on the skin (eg. ice pack), early application of a moderate to high potent topical corticosteroid plus topical fusidic acid combination and adequate sun protection in the form of a broad-spectrum sunscreen as well as physical sunlight protection methods go a long way in preventing the much-dreaded complication of post-inflammatory hyperpigmentation.

However, while considering the therapeutic results achieved with fractional laser resurfacing, it is pertinent to note that there is no iron-clad and uniformly objective assessment available currently in this regard. For, the criteria used by most clinical studies on fractional laser technology (for assessing the therapeutic results) is either quartile grading system or patient satisfaction. Needless to mention here that both these criteria are prone to subjective bias. Thus, it is imperative that a proper objective tool is devised with the aid of further study on the subject so as to accurately assess the therapeutic benefits across the whole spectrum of post acne scars.

Conclusion & Recommendations

Based on the study it can be concluded that fractional CO_2 laser treatment has contributed significantly not just in improving the clinical appearance and other parameters of the treatment areas but also in enhancing the quality of their life of these affected patients. However, it is pertinent to note that the morphology of scars exhibited by a patient may be of different types and grades. Hence, it may not be fruitful to treat all these scar types by using a single treatment option. Instead, multiple techniques may be required to achieve satisfactory results. Nevertheless, of all the treatment options available for post-acne scars, fractional photothermolysis is by far the only monotherapy which provides the greatest degree of scar amelioration.

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