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ROLE OF FRACTIONAL CARBON DIOXIDE LASER RESURFACING IN THE TREATMENT OF ACNE SCAR

Lubna Khondker[1*], Md Shirajul Islam Khan[2], Sharmin Begum[3], Abu Reza Sayem Ahamed[4], Toioba Akter[5], Pranam Swapan Dash[6]

[1*]Associate Professor, Department of Dermatology and Venereology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh. Email: lubnaderma@gmail.com
[2] Professor (Brigadier General) and Head, Department of Dermatology and Venereology, Combined Military Hospital (CMH), Dhaka, Bangladesh. Email: siraj824@gmail.com
[3]Assistant Professor, Department of Dermatology and Venereology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh. Email: karimnazmul16@gmail.com
[4]Assistant Professor, Department of Dermatology and Venereology, Mugda Medical College, Dhaka, Bangladesh. Email: sayem.ahamed@yahoo.com
[5]Junior Consultant, Department of Dermatology and Venereology, Dhaka Medical College Hospital, Dhaka, Bangladesh. Email: dr.t.akter01@gmail.com
[6] Medical Officer, Department of Dermatology and Venereology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh. Email: drbristi53@gmail.com

***Corresponding Author:** Lubna Khondker,
*Associate Professor, Department of Dermatology and Venereology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh. Email: lubnaderma@gmail.com

Abstract:
This study was performed to determine the effectiveness and safety of fractional CO_2 laser therapy in the treatment of acne scar. A prospective clinical trial was done in the Department of Dermatology and Venereology, Bangabandhu Sheikh Mujib Medical University (BSMMU) and Combined Military Hospital (CMH), Dhaka, to find out the efficacy and safety of fractional CO_2laser in the treatment of acne scars. A total of 60 patients with moderate to severe acne scars were treated with Fractional CO_2 laser therapy at baseline and after 4, 8, 12,20, and 28 weeks. It was found that among the 60 patients included in the study, the majority was below the age of 30 years and female. The acne scar was significantly reduced after 4, 8, 12, 20, and 28 weeks of treatment with Fractional CO_2 laser therapy. The level of improvement observed varied from excellent to poor, with the majority of patients experiencing fair to excellent improvement. The majority of patients tolerated the treatment with negligible adverse effects. It can be concluded that Fractional CO_2 laser is highly effective and well tolerated by patients in the treatment of acne scars.

Key words: Fractional CO_2 laser, acne scar, acne vulgaris, CO_2 laser, scar, laser.

Introduction

Acne vulgaris is a chronic inflammatory disease of the pilo sebaceous follicles, characterized by comedones, papules, pustules, nodules, and sometimes scars. The comedon is the primary lesion of acne. Acne is the most common skin disease among the teenagers affecting around 90% to some degree.[1-4]

Almost every individual in their lifetime have some experience of this disease. Involution of the disease develops before age 25.[5] Many a times acne recovers automatically even after years but should not leave it alone because untreated acne may produce ugly scars on skin.[6]Acne scar is developed after severe episodes of acne in teen and early adult life**.**[7]Unfortunately acne scar may occur in 95% of the cases before initiation of treatment.[5]

Acne scar may occur though there are excellent management options available. Smaller acne lesions may produce scarring in some individuals but it's being quite prominent and often results from the cystic acne. Pitted scars, wide-mouthed depressions and keloids are commonly affected along the jawline and chest.[5]Most scars recover within 2–3 years in young age, but in later years, scars specify due to decreases of skin's firmness and its oil supply absorption.[8]Scars developed asa result of skin damage during the process of healing. Many factors play a role in scar formation including age, ethnicity, heredity, size and depth of the wound.[9]Though in broad heading, there are atrophic and hypertrophic scars, but atrophic scars are divided into ice pick, rolling and boxcar type. Ice pick and dotted scars represents 65-70%, rolling type 20-30% and boxcar type around15-25%. Ice pick scars are narrow (2 mm), with a wide opening look like the letter V. Rolling scars are wider (up to 5mm) which reach up to the subcutaneous adipose tissue. It gives a distorted looks in the skin seems to the letter M. Boxcar scars have vertical edges those are wider than ice pick scars and resemble U shape with a broad and visible base. [4]To minimize the acne scar usually various topical medications such as tretinoin, vitamin C, hydroquinone, silicone gel and non-silicone sheets, intralesional corticosteroid injections, soft tissue fillers, chemical peeling, cryotherapy, microdermabrasion, intense-pulsed light laser, and radiofrequency are being used. More recently Fractional carbon dioxide (CO_2) lasers replaces some less successful treatments such as dermabrasion and chemical peeling.[10,11]

The term LASER stands for Light Amplification by Stimulated Emission of Radiation. Its primary characteristics are the collimation, coherent and monochromatic beam. Carbon dioxide (CO_2) laser has wavelength 10600 nm. The fractional carbon dioxide laser is being used in the management of many dermatological diseases and also aesthetic procedures. The advantage of CO_2 laser is the non-selective target in the body as its medium of absorption is water.[6,8,10-14] It can penetrate 20–60 µm depth of the skin thereby capable of causing thermal damage extending up to 20–50 µm of its surrounding zone.[15]Variable Microscopic Treatment Zones (MTZ) are formed according to the fluence used and the depth of penetration of laser beam. Thermal injury causes coagulation and denaturation of collagen and occurs re-epithelialization. Fractional ablation enabled the epidermis and dermis resulting re-epithelialization is facilitated from the surrounding non ablated skin and appendages. Ablative Fractional resurfacing with CO_2 laser (AFRCL) is evidenced based treatment options for atrophic acne scars of moderate-to-severe varieties. There are number of studies that support the efficacy of AFRCL for atrophic acne scars. FractionalCO_2 laser is the powerful weapon in the treatment of many dermatological conditions including scars, wrinkles, stretch-marks, dilated pores and benign growths on the skin.[7,14-20]Facial resurfacing with fractional CO_2lasers is currently claimed to be one of the most effective treatment options for facial acne scars. Fractional lasers treat only a column or a 'fraction' of the affected skin without intervening the untreated areas of skin. These untreated areas help in rapid re-epithelialization of the skin thereby minimizing the chances of serious scars and other adverse effects.[12,21,22]The advantage of Fractional carbon dioxide lasers over conventional surgery are shorter recovery time, less tissue damage and less erythema as well as edema. However, the thermal trauma to the surrounding tissue constituted major problem.[23]Complications of the treatment with fractional carbon dioxide laser may occurs due to excessive treatment on the affected area including more energy or density or both of them. Special precaution need to be taken for treating sensitive areas such as eyelids, upper neck, lower part of the neck, neckline and chest.[24,25]

Materials and Methods

A prospective clinical trial was done in the department of Dermatology and Venereology, Bangabandhu Sheikh Mujib Medical University (BSMMU) and Combined Military Hospital

(CMH), Dhaka for a period of January 2018 to December 2020. About 60 adults with moderate to severe acne scars was recruited. Consecutive type of non-probability sampling method was followed. Inclusion criteria included age older than 18 years, general good health, willingness to participate and ability to comply with the requirements of the protocol, and the presence of clinically evident acne scars. Potential participants were also excluded from the study for a history of active infections, keloid or scar formation, recent use of Isotretinoin, known allergies to lidocaine, cosmetic procedures within last 6 months, pregnancy and smoking. In addition, the patients were excluded from the study who did not agree to continue the research.

Aims and objectives of the study along with its procedure, probable adverse effects and benefits of this study have been discussed with the patients in easily understandable and local language prior to the commencement of this study. After thorough discussion, informed written consent was taken from each patient. Assurance had been given that the information and records will be kept confidential. The patients were explained that they had all the rights to refuse or accept to participate in the study and they would not receive financial benefit for this purpose. Data were collected by face-to-face interview and recorded in a questionnaire. Information was collected by taking medical history and the findings of clinical examination. Baseline laboratory investigations were done for the purpose of exclusion and monitoring the probable side effects. Laboratory investigations including complete blood counts, liver function tests, serum creatinine, random blood sugar and serum lipid profile level were done.

Table I: Qualitative scarring grading system.[26]

Grading of acne scar	Level of disease	Presentation
1	Macular	The scarsare erythematous, hyper or hypopigmented.
2	Mild	The scars are mild atrophic orhypertrophic. It may not be visible at a distance of 50 cm or greater and can be easily covered with makeup or shadow of shaved beard hair
3	Moderate	The scars are moderate atrophic or hypertrophic.Easily visible at social distance of 50 cm or greater, and cannot be covered with mascara or shadow, but can be flattened by manual pressure.
4	Severe	The scars are severe atrophic or hypertrophic. It can be easily recognized at a distance greater than 50 cm and cannot be covered with makeup and cannot be flattened by manual pressure.

The laser parameters like pulse energy, density, power, and number of passes required to be set which depends on the variants and duration of scars as well as the device being used. The static method and dynamic module were used directly on the lesion and at the periphery respectively. A less aggressive approach was given in darker skin types and over-sensitive areas to avoid undesired effects. The parameters ranging from 15-25 J/cm^2 was used at densities of 100-150 MTZ/cm^2, thereby provided about 40-45mJ of energy and an ablation depth of 1.0-1.2 mm at each spot. Usually single or double pass was used over each acne scar along with its margins. Each variant of scar was treated in a similar manner. The patients were treated with the Fractional CO_2laser at baseline and 4, 8, 12, 20 and 28 weeks subsequently. Topical anesthetics e.g., eutectic mixture of lidocaine/prilocaine (EMLA) applied for one hour before the laser procedure. The pain has been reduced to a tolerable degree, although few patients continued to feel mild pain and discomforts.The patient was advised to cool the skin with icepacks for 5-10 minutes after the procedure to take care of post-treatment erythema, edema and burning sensation.

Comparison was donefor the improvement rate of scars after every session to determine the outcome. Adverse effects were recorded in each session and visit. Persistent post-treatment erythema, edema, burning sensation, itching have been described as adverse reactions to this treatment option. A four point scale is used to measure the level of response to treatment, if>75% clear- Excellent response; if 50-75% clear- good response if 25-50% clear fair response; if <25% clear poor response. The patients were instructed to avoid sun exposure for the next 4-5 days after each procedure and a topical antibiotic cream was prescribed over this period. The patients were

also advised to use a broad-spectrum sunscreen liberally over the whole face. Data were edited, coded and analyzed by SPSS (Statistical Package for the Social Science) version 23.

Result:

A prospective type of clinical trial was done to find out the role of FractionalCo2 laser in the treatment of acne scar. Among 60 patients35(58.33%) was in the age group of between 20-30 years, and 15(25%) was between 31-40 years age group and 10(16.67%) was between 31-40 years age group. There were 24 (40%) males and 36(60%) females with a male-to-female ratio of 2:3(Table II). According to Goodman and his collages baron classification system, all patients were with moderate-to-severe atrophic scars, 70% had moderate acne scar, and 30% with severe grade of acne scars. Regarding morphologic variants of the scars,40% of patients had predominantly rolling scar, 47.5% had mixture of various morphologic scar and 12.5% had pitting scar. The cheek was found to be the most affected site (95%), followed by the temples (55.5%), and forehead (27.5%) and Chin was affected in four patients (14%).After 4 weeks of treatment by Fractional CO_2 laser, level of improvement was excellent 3.3%, good 13.33%, fair 11.67% and poor 71.67%; after 8 weeks of treatment, excellent was 10%, good was 23.33%, fair was 13.33% and poor 53.33%; after 12 weeks of treatment, excellent was 13.33%, good 26.67%, fair 16.67% and poor 43.33%; after 20 weeks of treatment, excellent was 20%, good 30%, fair 20% and poor 30% and after 28 weeks of treatment, excellent was 25%, good 33.33%, fair 21.67% and poor 20(Table III).

All of them had an improvement in their acne scarring with variable grade. Fifteen of the patients showed almost clearance of scarring (Excellent), a large number 20patients showed marked improvement (good)while 13 patients showed moderate improvement of acne scar (fair) and 12patients showed minimal improvement those had moderate to severe types of acne scars (Table IV). Regarding safety level, out of 60 patients of acne scars treated by Fractional Co2 laser, about 52(86.7%) patients did not observe any side effects. Among the 8(13.3) treated by Fractional Co2 laser, 4(6.7) patients showed mild erythema which was transient and recovered at its own,2(3.3) patients showed oedema with erythema which improved after 2-3 days, but there was remarkable superficial crusting which remained for 4-7 days. They could return to work within 3-4days after applying sunscreen and topical antibiotic cream. One patient experienced burning sensation and pruritus which may be due to the adverse effects of local anesthetics. There were no pigmentary changes, infections and other immediate adverse effects. No long-term side effects were observed after 3 months of follow-ups and improvement continued after the last sessions (Table V).

Table II: Demographic characteristics of patients (n=60)

Age group	Male	Female	Total
20-30 Years	15	20	35(58.33%)
31-40 Years	5	10	15(25%)
41-50 Years	4	6	10(16.67%)

Table III: Distribution of the patients by level of improvement (n=60)

After 04 weeks	After 08 weeks	After 12 weeks	After 20 weeks	After 28 weeks
Excellent 2(3.3%)	Excellent 6(10%)	Excellent 08(13.33%)	Excellent 12(20%)	Excellent 15(25%)
Good 08(13.33%)	Good 14(23.33%)	Good 16(26.67%)	Good 18(30%)	Good 20(33.33%)
Fair 07(11.67%)	Fair 08(13.33%)	Fair 10(16.67%)	Fair 12(20%)	Fair 13(21.67%)
Poor 43(71.67%)	Poor 32(53.33%)	Poor 26(43.33%)	Poor 18(30%)	Poor 12(20%)

Table IV: Distribution of the patients by scale of Improvement

Scale of Improvement	Percentage of Improvement
0-25% Poor/ minimal improvement	12(20%)
26-50% Fair/ moderate improvement	13(22%)
51-75% Good/marked improvement	20(33%)
>75% Excellent/ almost clearance of scarring	15(25%)

Table V: Distribution of the patients by level of safety (n=60)

Safety	Number (%)
With side effects	8(13.3)
• Erythema	4(6.67%)
• edema with erythema	2(3.33%)
• Burning sensation	1(1.67%)
• Pruritus	1(1.67%)
Without side effects	52(86.7%)

Discussion:

A prospective clinical trial was done with60 patients with acne scars, treated with Fractional CO_2 laser therapy. In our study we have included 24 male and 36 female patients with the mean age 26.1yrs. Acne scars classified according to Goodman and Baron and each patient was treated 5 sessions where initial 3 sessions 4 weeks interval and final 2 sessions 08 weeks interval. After 28 weeks of treatment the level of improvement was excellent 25%, good 33.33%, fair 21.67% and poor 20% and regarding safety level, about 52(86.7%) patients did not notice any side effects.

Our study findings have similarity with study of Al-Bazzaz and Al Omary et al. They have evaluated four hundred individuals. Of them, 188 males and 212 were females with a mean age of 34 years and clinically evident acne scars on the face met inclusion criteria. Each patient underwent 3-5 sessions once monthly, where they have found the depth of the scar have been improved in 55 patients by 30-40% in 96 patients by 40-50%, in 190 patients by 50-60%,in 35 patients by 60-70% and the maximum improvement appeared in 24 patients by 70-80%.[27]

When comparing patients randomized to receive either 3-5 laser treatment sessions, no statistically significant differences in efficacy at any time point or for any subtype of acne scars were demonstrated. A separate analysis of the time duration within each treatment group by the variance revealed that the depth of the scar was the only clinical end point to show a significant decrease in depth of the scars compared with baseline levels on the treated area of the face. Abdul Hakeem Mohammad Saeed, Salaiman Ayed Alsaiari, et al conducted a study with the cases moderate-to-severe atrophic post-acne scars. At the 4-month follow-up visit after the last laser session, a positive response with either good or excellent results was documented in 30 patients (75%) of the study group. Of these 30 responders, >75% improvement was seen in seven patients (17.5%). While in 7 others, the improvement was in the range of 51–75%. Thus, excellent response (score 2 or more on quartile grading scale) was observed in a total of 14 patients (37.5%). Sixteen patients (40%) showed a good response while 10 patients failed to demonstrate any significant response to treatment with <25% improvement on the quartile scale. [28]The findings are almost similar to our study. Rima Shrestha et al showed the improvement in their study.[29]After the first laser session, their patients showed 10-25%, at the second session 20-45% and at the third session 30-60% reduction in the size of the acne scars which is also similar to our study.

In our study, we revealed few side effects (8 patients) after laser treatment, four of eight patients showed erythema which subsided without any medication. One of each patient had pruritus and burning sensation. Two out of eight patients had slight oedema on the cheek. Both edema and erythema recovered after 2-3 days, but there was mild crusting. It became normal within 3- 5 days after applying sunscreen and moisturizing lotion. There were no post inflammatory hyperpigmentation, infections and other adverse effects. Rima Shrestha, Anupama Karki et al found similar types of side effects which includes burning during laser procedure, post-treatment crusting, scaling and transient pigmentation, which remained for 4-7 days. They could return to their routine daily life 4days after applying sunscreen and moisturizing lotion.[29] Simin Saryazdi and Azadeh Mohebbi also noted in their study that few patients experienced mild pain, edema, and erythema those improved after 2-3 days, so they could return to work after few days. None of the study observed any long-term side effects after 6 months of follow up and the improvement continued after the last use of laser.[30]

Conclusion:

The study concludes that fractional CO^2 laser therapy is highly effective and well tolerated by patients in the treatment of acne scars. This finding has important implications for the management of acne scars and provides evidence for the use of this treatment modality in clinical practice.

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