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A Split-Face Comparative Study of ACNE Scar Treatment Using Microneedle Radiofrequency Plus Fractional Carbon Dioxide (Co2) Versus Microneedle Without Radiofrequency Plus Carbon Dioxide (Co_2)

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ABSTRACT

Objective: To compare microneedle radiofrequency plus fraction CO_2 application on one side versus microneedle without radiofrequency plus CO_2 application on the other side of the face in the treatment of acne scars.
Study Design: Quasi-experimental study.
Place and Duration of Study: Dermatology Department, Ghurki Trust Teaching Hospital, Lahore, Pakistan, from Apr 2021 to Jan 2022.
Methodology: A total of 78 patients of both genders between the ages of 15 to 45 years having acne scars with Grades 2–4 were included. Patients with history of previous acne treatments, pregnancy, and ischemic heart disease were excluded. It was a split-face study in which 78 patients underwent acne scar treatment with microneedle radiofrequency plus fraction CO_2 on left side of face and microneedle without radiofrequency plus CO_2 application on the right side of face. All patients were followed 2 months after the completion of treatment.
Results: The mean age of patients was 25.95±6.61 years. There were 52 females (66.7%) and 26 male patients (33.3%). The mean Goodman and Baron Scar score at the start of treatment and at 2 months follow up reduced from 31.64±4.13 to 8.73 ± 3.07 on left side of face while it decreased from 30.49±4.08 to 10.96±3.08 on right side of face, the difference between the groups was statistically significant (p<0.001).
Conclusion: Microneedle radiofrequency plus fraction CO_2 application is better than microneedle without radiofrequency plus CO2 application in the treatment of acne scars.

Keywords: Acne scars, Microneedling, Radiofrequency.

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INTRODUCTION

According to The Global Burden of Disease project, acne is the eighth most prevalent global ailment. An estimated 9.4% of the world population is affected.[1] Acne scarring is one of the most frequently encountered complication of facial acne which can have a profound detrimental impact on the patient's emotional and physical well-being.[2] Facial disfigurement resulting from permanent acne scars causes marked psychosocial morbidity. Acne scarring occurs secondary to disproportionate and disorganized deposition and production collagen around the inflamed follicles in the skin.[3] Acne constitutes more than 20% visits to dermatology outpatients in the Pakistani population with the disease more common amongst adolescents.[4]

Clinically significant acne scarring on face responds poorly to medical management and is reported in more than half of the patients of younger age groups.[5] The risk factors for development of acne scars include male gender, early onset of acne, severe form of acne, duration of disease, delay in treatment to name a few.[6] Acne scars have been classified as hypertrophic and atrophic scars. The different varieties include boxcar, ice-pick, linear, pitted and rolling scars.[7] A number of treatment modalities have been proposed. These include invasive options like scar revision, excision of scars, grafting, autologous fat transfer, dermal filling, and dermabrasion. The conservative options include chemical peeling, use of platelet rich plasma (PRP), cryotherapy, ablative and non-ablative lasers.[8,9]

Fernandes introduced microneedling for treatment of acne scars describing it as a technique of percutaneous collagen induction as an alternative to laser resurfacing. Microneedling has been combined with radiofrequency and CO_2 lasers as a combination therapy to add the benefits of both treatments.

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Radiofrequency ablation releases electromagnetic radiation that disrupts the dermis with minimal damage to epidermis, promoting neocollagenesis and skin contraction and thus produces less hyperpigmentation and complications.[9,10] Fractional CO_2 laser boasts an excellent low side effect profile as compared to conventional laser therapy, with the added advantage of efficient skin rejuvenation and smaller recovery periods.

This research protocol is the first study of its kind in the Pakistani population as well as international literature comparing microneedle radiofrequency plus fractional CO_2 application versus microneedle without radiofrequency plus CO_2 application in the treatment of acne scars. The primary objective of our study was to identify the most effective treatment option for patients presenting with acne scars and to determine if radiofrequency augmented Microneedling with CO_2 application is an effective approach.

METHODOLOGY

The quasi-experimental study was conducted on a total of 78 patients reporting to the Department of Dermatology, Ghurki Trust Teaching Hospital, Lahore, Pakistan from April 2021 to January 2022, with acne scars after approval from hospital ethical review committee (LMDC/17035-36 dated 9 April 2021). Informed consent was taken from patients before inclusion in the study. The sample size calculation was done by using WHO sample size calculator by applying the "Estimating the difference between two population proportions" test by taking a confidence level of 80%, absolute precision required of 0.10, anticipated population proportion 1 of 63.41% and anticipated population proportion 2 of 60.72% (Improvement in Baron and Goodman Scores). The total sample size was 78 patients since it was a split-face study. Consecutive nonprobability sampling was employed.

Inclusion Criteria: Patients of both genders between the ages of 15 to 45 years having acne scars of Grades 2–4 as per the Goodman and Baron's Scar Grading System were included in study. Fitzpatrick skin types II to V were included in the sample.

Exclusion Criteria: Patients who had previously undergone management of acne scars like skin resurfacing therapy, laser therapy, chemical restoration of skin scars, patients who were pregnant or presently breastfeeding, patients with a history of keloid formation, ischemic heart disease, coagulopathies, and active skin infections were excluded from the study. Patients who did not complete the treatment protocol and those who were lost to follow-up were also excluded from the study.

The demographic details were documented, and photographs of both sides of the face were taken before the start of treatment, after taking consent from all patients. The study recruited 85 patients, but 7 patients were lost to follow-up, and 78 patients completed the study. A detailed explanation about the procedure was given to participants included in the study. The Grading of the acne scars was done using the Goodman and Barons score.[9] The skin of face was anesthetized by applying a local anesthetic cream containing Prilocaine and Lignocaine one hour before the procedure. Patients received treatment for acne scars on their faces using two different methods. The left side of each patient's face was treated with microneedle radiofrequency combined with fractional CO_2 application. In contrast, the right side was treated with microneedles alone, followed by CO_2 application. This study organized the treatments into two groups: Group-A included the left-sided treatments, while Group-B consisted of the right-sided treatments Figure-1.

Figure-1: Photographic Images of A Patient Before and After Treatment

All patients underwent 4 sessions of treatment, with each subsequent session performed 6 weeks apart. Patients were followed after 2 and 4 weeks of each session. The final follow-up was performed 2 months after the last session. The Goodman and Baron Scar score was again calculated, and the percentage decrease in score was documented. The photographs of both sides of face were again taken with the consent of the patients. Photographs of one of our patients is shown in Figure-2.

Microneedling passes were set at 3.5 mm, followed by 2.5 mm and 1.5 mm. Microneedling with

radiofrequency was used on the left side of the face, followed by CO2 application, while right-sided scars were treated with Microneedling alone, followed by CO_2 laser treatment. The radiofrequency intensity level was set from 5 to 10, with energy set at 40 W to 25 W, with a mode of 2 MHz, respectively. The wavelength of CO_2 used was set at 10.6µm. After the respective sessions, all patients were advised to use a good broad-spectrum sunscreen and to strictly avoid direct sunlight. Acetaminophen and cold compresses were advised for pain relief.

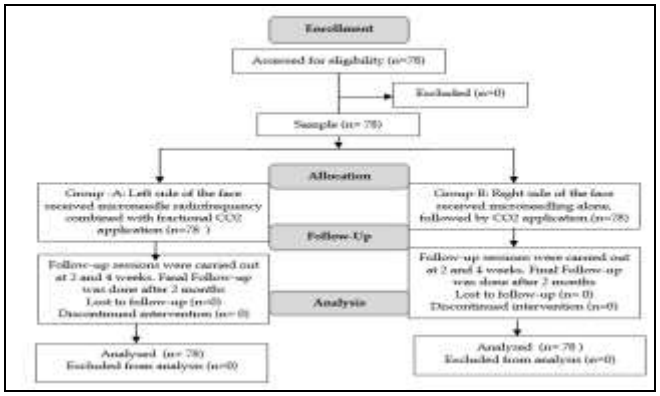

Figure-2: Patient Flow in a Split-face Comparative Study of Acne Scar Treatment (n=78)

Mean±SD were calculated for numerical variables like age and Goodman and Baron Scar score before and after treatment. Categorical variables like gender, grade of acne scar, Fitzpatrick skin types, reduction in scar score, and the percentage improvement in scar score were presented as frequency percentages. Independent sample T-test was applied to compare the numerical variables, while categorical variables were compared by applying the Chi-square test, taking *p*-value ≤0.05 as statistically significant.

RESULTS

A total of 78 patients completed the study. The mean age of patients was 25.95±6.61 years. The study revealed a female gender preponderance with 52(66.67%) patients, while the study sample comprised only 26(33.33%) male patients. The male-to-female ratio was 1:2. The most common acne scar grade was grade 4 in 34 out of 78 patients (43.6%). And the most common Fitzpatrick skin type was type III in 36 out of 78 patients (46.2%). The distribution of patients according to acne scar grade and Fitzpatrick skin type is given in Table-I.

Table-I: Distribution of Patients According to Acne Scar Grade and Fitzpatrick Skin Type (n=156)

Groups	Grade Groups	n (%)
Acne Scar Grade	Grade 2	11(14.1)
	Grade 3	33(42.3)
	Grade 4	34(43.6)
Fitzpatrick Skin Type	II	11(14.1)
	III	36(46.2)
	IV	22(28.2)
	V	9(11.5)

The distribution of patients according to Goodman and Baron scar score at the start and end of treatment (at 2 months follow-up) is given in Table-II.

Table-II: Goodman and Baron Scar Score Comparison Between Start and End of Treatment (n=156)

Scar Score Comparison	Group-A (n=78)	Group-B (n=78)	*p*-Value
	Mean±SD	Mean±SD	
Scar Score at Presentation	31.64±4.13	30.49±4.08	0.081
Scar Score at 2-month Follow-up	8.73±3.07	10.96±3.08	<0.001
Reduction in Scar Score	22.78±3.98	19.12±3.83	<0.001

Thus, the percentage reduction in scar score on left side of face was 72% while on the right side of the face it was 62.7%, the two groups varying by statistically significant difference (p<0.001). The comparison of the two groups in terms of percentage improvement in scar scores is given in Table-III.

Table-III: Comparison Of Improvement In Scar Score Between the Two Groups (n=156)

Improvement in Scar Scores	Group-A n (%)	Group-B n (%)	*p*-value
More than 75%	43(55.13)	6(7.69)	<0.001
51-75%	32(41.03)	63(80.77)	
26-50%	3(3.85)	9(11.54)	
Less than 25%	-	-	

DISCUSSION

Over the past few decades, significant progress has been made in identifying effective treatment options for acne scars, and the newly introduced techniques have proven to be revolutionary. This split-face study, with Group-A representing the left half of the face and Group-B representing the right half. The mean age of the patients included was 25.95±6.61 years. This study sample showed a female predominance, with a male-to-female ratio of 1:2. Literature has shown varying gender ratios such as Rajput et al. reported that 54% of

patients were female, while Nandini *et al*., reported a higher percentage of male patients at 60%.[11]

The commonest grade of acne scar in the current study was Grade 4 in 43.6% patients. Rajput *et al*., also reported Grade 4 as the commonest grade in 52% patients.[12] The overall mean scar score at the start of treatment of all patients was 31.06±4.13. The study reported a mean scar score of 33.24±4.7 in patients undergoing microneedling radiofrequency.[13] No previous study has compared the combination of CO2 with microneedling radiofrequency and microneedling alone. This study found a statistically significant improvement in the scar scores on 2-month follow-up in Group-A (left side of the face) as compared to Group-B. The percentage improvement between the two groups was 72% and 62.7% respectively (p<0.001).

Faghihi *et al*., from Iran reported that Grade 3 scarring occurred in 60% patients and Grade 4 acne scars in 40% patients. The most common Fitzpatrick skin type in our study was type III in 46.2% patients, followed by Type IV in 28.2% patients. It also reported Type III as the most common skin type in 64% patients.[13] The Goodman and Baron quantitative acne scar scoring system was used to assess the efficacy of both treatments in this study.[14]

A study conducted in Turkey by Kaçar *et al*., found no statistically significant change in the mean Visual Analog Scale (VAS) patient satisfaction scores in subsequent visits compared to Visit 2 for both treatment groups (p>0.05). The side effects observed were similar, but they lasted longer in the fractional carbon dioxide (FCO_2) group. Both FCO2 and fractional radiofrequency (FRF) are effective treatment methods for atrophic acne scars. Additionally, combining FCO_2 with FRF enhances patient satisfaction. The results suggest that FRF may be more effective for women than for men.[15]

Research conducted by Nandini *et al*., found that the combined use of microneedling and PRP (Platelet-Rich Plasma) was more effective than using either method alone for treating acne scars. Although the treatment approaches differ from those in the current study, their findings emphasize that combination therapies have generally proven to be more effective in addressing acne scars on the face.[16]

Another study by Tatlıparmak *et al*., studied the effect of a combination of CO_2 with microneedling radiofrequency and reported outcomes in terms of ECCA score (Echelle d'Evaluation Clinique des Cicatrices d'Acné). The study reported significant improvement in acne scars on a 1-month follow-up.[17] When compared with current study it was also found that Grade 4 improvement or more than 75% improvement was reported in 55.13% patients in Group-A while only 7.69% patients in Group-B had Grade 4 improvement in acne scars, the difference between the two groups being significant (p<0.001).

Studies, like Reddy *et al*., have compared fractional CO_2 application with microneedling radiofrequency in acne scars as separate treatment strategies, but not as a combined option.[18] Juhasz *et al*., recommended microneedling for darker Fitzpatrick skin types, such as that of majority of the South Asian population.[19]

The combination of microneedling with radiofrequency and CO2 appears to be a promising treatment option for acne scars. This is a pilot study, and further research is recommended with a larger sample size and a wider range of variables, such as cost-effectiveness and long-term complications, to establish a standard treatment approach for patients with acne scars.

LIMITATION OF THE STUDY

The limitation of our study was that the sample size was small, and the adverse effects were not studied; further research with larger sample sizes is recommended.

CONCLUSION

Microneedle radiofrequency plus fractional CO2 application was found to be significantly better than microneedle without radiofrequency plus fractional CO2 application in the treatment of all grades of acne scars and all skin types.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

BJB & SH: Data acquisition, data analysis, critical review, approval of the final version to be published.

HN & TA: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

SIG & TC: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity

of any part of the work are appropriately investigated and resolved.

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