



Original Article

Comparative study in treatment of acne scars fractional carbon dioxide laser versus micro needling fractional radio frequency – A retrospective study

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ABSTRACT

Objectives: Efficacy of fractional carbon dioxide laser and microfractional radiofrequency in treatment of acne scars is well substantiated. The objective of this study was to compare the efficacy and safety of carbon dioxide laser versus microfractional radiofrequency in treatment of acne scars in skin type 3,4.

Material and Methods: Thirty-two patients of skin types 3–4 with grade 3 and 4 atrophic acne scars, of which 16 were treated with fractional carbon dioxide (CO₂) laser and 16 were treated with microfractional radiofrequency were retrospectively analyzed. All patients received either treatment 4 sessions at an interval of 4–6 weeks. Objective assessment was done with qualitative and quantitative Goodman and baron acne scar grading system by assessment of photographs at baseline and 3 months after last session.

Results: All the data collected were entered in a Microsoft Excel worksheet and analyzed using R Software R-4.2.1. The study variables acne scar grades were described using frequency with percentage, acne scar scores were described using Mean with Standard deviation, and Median with interquartile range (IQR) (Q1-Q3). Since the data were ordinal, which is non-normal, hence, non-parametric tests are applied. To compare grades between the groups, Mann-Whitney U-test was applied.

Conclusion: There was no difference in the last session (after the treatment) between the groups, the Mann-Whitney U-test was 109.5 with *P*-value of 0.484 >0.05. Therefore, there was no statistically significant difference between the microfractional radiofrequency and carbon dioxide laser group. There were 2 (12.5%) cases reported with post-inflammatory hyperpigmentation in the CO₂ laser group and zero cases in the microfractional radiofrequency group.

Keywords: Acne scars, Fractional CO₂ laser, Microfractional radiofrequency

INTRODUCTION

A fractional laser resurfacing technique, based on the principle of fractional photothermolysis, causes microscopic treatment zones of complete epidermal ablation with variable amounts of dermal coagulation.¹ It results in microscopic pattern with spatial separation of columns of thermally affected epidermal and dermal tissue. Unlike ablative lasers, it is not associated with extended post-operative recovery period, prolonged erythema, and worsening of the scars which hinder application of this technique in dark skinned individuals.²

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Fractional bipolar radiofrequency technique based on creating radiofrequency thermal zones without epidermal injury can be used to induce natural neo collagen in skin. After damage to the reticular dermis, long-term dermal remodeling, ne elastogenesis and neocollagenesis results in dermal thickening. With this modality, only 5% of epidermis is affected compared to 10–70% with fractional ablative laser treatment.³

Although fractional carbon dioxide (CO₂) laser and micro needling fractional radiofrequency have gained acceptance, studies comparing efficacy and side effects are lacking. This study has been done to compare efficacy and safety in treatment of acne scars using fractional CO₂ laser and microneedling radiofrequency.

MATERIAL AND METHODS

A retrospective photographic analysis of 32 patients, of which 16 patients treated with fractional CO₂ laser and 16 patients treated with microfractional radiofrequency of facial atrophic scars between November 2012 and December 2013 were done. None of the patients had received any treatment for acne scars. Patients were excluded if they had received other modalities of treatment for acne scars.

Patients had undergone either treatment for acne scars, four sessions with an interval of 4–6 weeks between each session. Treatment regimen was individualized based on predominant scar type, scar depth, and fibrosis of dermal tissue.

The treatment areas were cleansed of debris, including dirt, make up and powder, using mild cleanser and 70% isopropyl alcohol. Lidocaine 2.5% and prilocaine 2.5% cream were applied under occlusion to the treatment area. After an hour of application, the anesthetic cream was gently removed, and then alcohol was used to degrease the skin to obtain a completely dry skin surface. All subjects were treated by a single operator.

In microfractional radiofrequency (Infini-lutronic), high-energy settings, 25W–30W, respectively, were used at lower penetration depths to prevent epidermal coagulation, penetration depth limited to 1.5 mm on forehead, and temple areas with bony prominences. Patients with predominantly ice pick scars and mixed scarring were given a needle depth of 3.5 mm on first pass and 2.5 mm on the second pass and third pass with minimal or no overlapping.

In fractional CO₂ laser (ECO₂-Lutronic), full face was treated in rejuvenation mode with power of 20–30W, energy of 20–30 mJ, 100 spots/cm², scan size 18 × 18 with 300 tip single pass followed by 2 passes over atrophic scars with power of 60–80 W, energy of 20–30 mJ, 50 spots/cm², and scan size of 8 × 8, with 120 tip.

Post-procedure ice compresses were given for 15–20 min, pain was managed by oral non-steroidal anti-inflammatory

drugs. Patients were advised strict sun protection along with reepithelialization agents containing cyclopentasiloxane, cyclohexasiloxane, and sodium hyaluronate. Post CO₂ laser, patients had downtime of 5 days unlike microfractional radiofrequency patients who could resume their work from next day.

A single non-treating physician assessor evaluated clinical response to treatment by goodman and baron acne scar grading system by assessment of photographs at baseline and 3 months after the last session. Digital photographs were obtained using identical camera settings and lightening conditions at each follow-up session.

Assessment of efficacy

Objective assessment of physician scores of improvement was determined by goodman and baron global acne grading system.

Statistical analysis

All the data collected were entered into a Microsoft Excel worksheet and analyzed using R Software R-4.2.1. The study variables acne scar grades were described using frequency with percentage, acne scar scores were described using mean with standard deviation, and median with interquartile range (IQR) (Q1-Q3).

Since the data were ordinal, which is non-normal; hence, non-parametric tests are applied. To compare grades between the groups, Mann–Whitney U-test is applied. To compare the pre-post-intervention, the Wilcoxon Signed-Ranks test is applied.

RESULTS

In Table 1, it shows that in the first session, the median score in the Infini group was 17 (13–26) IQR, and in the CO₂ group was 21.5 (15.3–24), the Mann-Whitney U test was 111.5 with a *P*-value of 0.533 > 0.05, there is no statistically significant difference at a first session between the groups.

Similarly, there was no statistically significant difference in the last session (after the treatment) between the groups, the Mann–Whitney U-test was 109.5 with *P*-value of 0.484 > 0.05. Therefore, there is no statistically significant difference in the first session and last session between the Infini and CO₂ groups.

To compare the improvement from the first session to the last session among the groups assessed, the Infini group had the median difference score with IQR of 5.5 (4.3–8), with Wilcoxon Signed-Rank test –3.529 and *P*-value of 0.00041 < 0.05. Therefore, there is a statistically significant difference from the first session to the last session in the Infini group.

Table 1: Comparison of scores of acne scar at first and last session of the groups.

First session	n	Min-Max	Mean±SD	Median (Q1-Q3)	Mann-Whitney U	P-value
Infini	16	8–33	19.19±7.28	17 (13–26)	111.5	0.533
CO ₂	16	12–38	21.31±7.38	21.5 (15.3–24)		
Last Session						
Infini	16	6–22	12.56±5.06	11 (8–17.5)	109.5	0.484
CO ₂	16	7–34	14.88±7.68	12.5 (9.3–18.8)		
At	Paired difference (Before-After)				Wilcoxon signed ranks test	P-value
First session to last session	n	Min-Max	Mean±SD	Median (Q1-Q3)		
Infini	16	1–17	6.63±4.06	5.5 (4.3–8)	–3.529	0.00041
CO ₂	16	2–16	6.44±4.59	4.5 (3–8.5)	–3.523	0.00042

Q: Quartile, SD: Standard deviation, CO₂: Carbon dioxide

Similarly, in the CO₂ group, the median difference score with IQR was 4.5 (3–8.5), with Wilcoxon Signed-Rank test –3.523 and *P*-value of 0.00042 < 0.05. Therefore, there is a statistically significant difference from the first session to the last session in the CO₂ group.

Therefore, there is an overall improvement in both Infini and CO₂ groups.

In this study, from Table 2, 16 patients participated in each group. Most patients had mixed types of atrophic acne scars including ice pick, box scar, and rolling scars. Estimation of improvement with Goodman and baron qualitative acne scarring system was done.

Out of the 16 patients who underwent microfractional radiofrequency, 8 (50%) patients had a grade of 4 before the treatment, and all 8 had improved and reduced to grade 2. 6(37.5%) patients had a grade of 3 before, and 4 (66.7%) reduced to grade 1 [Figure 1a and b] and 2 (33.3%) reduced to grade 2. Two (12.5%) patients had grade 2 before the treatment and all two were reduced to grade 1. Rolling scars and box scars showed better improvement than ice-pick scars.

Out of the 16 patients who underwent CO₂ laser, 6 (37.5%) patients had a grade of 4 before the treatment, 5 (83.3%) had improved and reduced to grade 2 [Figure 2a and b], and 1 (16.7%) had reduced to grade 3. Eight (50%) patients had a grade of 3 at before, and 5 (62.5%) reduced to grade 1 and 3 (37.5%) reduced to grade 2. Two (12.5%) patients had a grade of 2 before the treatment and all two were reduced to grade 1. There were 2 (12.5%) cases reported with post-inflammatory hyperpigmentation in the CO₂ group and zero cases in the Infini group.

As shown in Table 1, the Mann–Whitney U-test was 109.5 with *P*-value of 0.484 > 0.05.

Therefore, there is no statistically significant difference in the first session and last session between the Infini and CO₂ groups.

Table 2: Assessment of acne scar grades before and after the procedures among the Infini and CO₂ groups.

Infini	Grades after			Total
	1	2	3	
Grades before				
2	2 (100%)	-	-	2 (12.5%)
3	4 (66.7%)	2 (33.3%)	-	6 (37.5%)
4	-	8 (100%)	-	8 (50%)
Total	6 (37.5%)	10 (62.5%)	-	16
CO ₂	Grades after			Total
	1	2	3	
Grades before				
2	2 (100%)	-	-	2 (12.5%)
3	5 (62.5%)	3 (37.5%)	-	8 (50%)
4	-	5 (83.3%)	1 (16.7%)	6 (37.5%)
Total	7 (43.7%)	8 (50%)	1 (6.3%)	16

CO₂: carbon dioxide

**Figure 1:** (a) Grade 3 acne scars before microfractional radiofrequency. (b) Improvement to grade 1 post-microfractional radiofrequency.

DISCUSSION

Acne scarring is known to impart a heavy psychosocial burden on patients and it is of utmost importance to treat them. There are a wide range of ablative, fractional ablative, fractional non-ablative lasers, radiofrequency microneedling, and combination therapies to treat acne scars.



Figure 2: (a) Grade 4 acne scars before carbon dioxide (CO₂) laser. (b) Improvement to grade 2 post CO₂ laser.

CO₂ laser resurfacing has been used for more than 20 years. Newer versions of CO₂ utilize fractionated laser beams rather than non-fractionated devices. Fractional laser resurfacing has been proven effective for treatment of acne scars.⁴ It basically utilizes light-based energy to destroy columns of skin which stimulates production of new collagen fibers, elastic fibers, and epidermis.⁵ However, this treatment has been associated with adverse events such as persistent erythema, scarring, infection, and pigmentary changes.

Non-ablative fractional lasers are useful for patients with superficial acne scars or those who do not have the time for a fully ablative procedure. They do not vaporize the skin, instead they heat and stimulate reparative mechanisms to remodel which results in faster healing. However, there was higher incidence of hyperpigmentation.⁶

You *et al.* have compared ablative fractional CO₂ with ablative CO₂ (non-fractionated), Er Yttrium Aluminium Garnet (Er YAG), and fractional erbium 1550 nm. The data suggest that ablative fractionated laser was as effective as non-fractionated laser with less erythema. However, non-ablative lasers had significantly less improvement. Based on this study, it seems reasonable to utilize ablative fractional resurfacing as primary mode of treatment in moderate to severe acne scars.⁷

Microneedling radiofrequency has the advantage of avoiding hyperpigmentation unlike fractional ablative and non-ablative lasers especially in darker skin types. It creates thermal zones of injury without targeting the epidermis. It involves use of insulated microneedles which produce electrothermal damage only at tip and produces collagen through release of growth factors.⁸

Qian *et al.* have done study in treatment of acne scars with fractional CO₂ laser (Active Fx-Lumenis). In this study, 31 patients received three sequential treatment were given over 6 months, and evaluation was done at 3 and 12 months after final treatment. About 12.9% patients showed excellent improvement in acne scars, while 38.71% noted good to fair results. Four patients had transient post-inflammatory hyperpigmentation and three were noted to have prolonged

erythema. However, in our study, only two had post-inflammatory hyperpigmentation as adverse effect.⁹

Gold and Biron have conducted clinical trials in treatment of acne scars using bipolar radiofrequency (matrix-radiofrequency [RF]). Fifteen subjects with mild-to-moderate acne scars received three monthly treatments and noticed significant improvement in acne scars, fine lines, and wrinkles. Adverse effects were limited to transient erythema, stinging. However, in our study, no adverse effects were reported and patients tolerated a procedure well.¹⁰ Ramesh *et al.* treated facial acne scars of 30 subjects (skin types IV-VI) with a matrix tunable radiofrequency device that was safe in skin types IV to VI. To conclude bipolar radiofrequency, RF technology is safe in all skin types as proven by all studies including current study.¹¹ From the available literature search, there are two studies comparing the efficacy and safety of microfractional radiofrequency and CO₂ laser.

In our study, both microfractional radiofrequency and CO₂ laser were equally effective in treatment of atrophic acne scars consistent with study by Zhang *et al.*¹² Rajput *et al.*¹³ too post-inflammatory hyperpigmentation, however, was reported with CO₂ laser which makes fractional radiofrequency as better choice in skin type IV-VI.

The advantage of CO₂ laser was that it was effective in popular scars over the nose and this area could not be treated with microfractional radiofrequency.

The limitation of this study was that we have done retrospective study, limited sample size, and no histological evaluation was done.

CONCLUSION

Fractional microneedling radiofrequency and fractional CO₂ laser are equally effective for treatment of atrophic acne scars. However, fractional radiofrequency has less down time and Post Inflammatory Hyperpigmentation (PIH), making it an efficient and safer treatment option in darker skin types.

Authors' contributions

All the authors, Rashmi Sriram, B S Chandrashekhar, Madura C and Harshvardhan Gowda have contributed to the research study. They have contributed in the collection of data, consent, design, statistics, analysis and review of study.

Ethical approval

Institutional Review Board approval is not required because the study is a retrospective study.

Declaration of patients consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

There are no conflicts of interest

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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