COMPARATIVE STUDY OF FRACTIONAL CO2 LASER AND DERMAROLLER IN THE TREATMENT OF ATROPHIC FACIAL ACNE SCARS

Virendra Vijay Saoji[1], Mrinmayee Mukund Ganoje[2]

[1]Associate Professor, Department of Dermatology, Dr. Panjabrao Deshmukh Memorial Medical College, Maharashtra.
[2]Junior Resident, Department of Dermatology, Dr. Panjabrao Deshmukh Memorial Medical College, Maharashtra.

ABSTRACT

BACKGROUND

Atrophic scars results from any inflammatory skin disease causing sufficient damage to epidermis and dermal collagen. The most common causes of atrophic scars are severe nodular or nodulocystic acne. Main morphological types of atrophic post-acne scars are icepick scars, superficial or deep boxcar scars and rolling scars and various modalities of treatments are available.

MATERIALS AND METHODS

Total of 50 cases were enrolled in study with grade 2 and 3 acne scars according to Goodman and Baron qualitative scar grading scale treated randomly selected modality of treatment by envelope method followed by alternate modality of treatment with 25 cases of each modality. Patients were selected with the predetermined inclusion and exclusion criterias. Patient followed up monthly after initiation of therapy for a period of six months.

RESULTS

All patients in Dermaroller group improved of which 88% improved by at least one grade and 12% patients showed improvement of the scars by 2 grades in Goodman and Baron qualitative scar grading scale. All the patients in fractional CO2 laser group showed improvement, of which 80% improved by 1 grade and rest 20% by another 2 grades in Goodman and Baron qualitative scar grading scale.

CONCLUSION

It is important to realise that a typical patient has scars of different morphological types and grades and it is difficult to treat all these scar types satisfactorily with a single treatment option. However, of all the treatment options available to treat post-acne scars, fractional photothermolysis is probably the only monotherapy that offers the highest degree of scar amelioration and patient satisfaction. On the other hand, Dermaroller is a simple, inexpensive office method of treatment for management of facial acne scars with relatively less downtime, but less satisfactory results as compared to fractional CO2 laser.

KEYWORDS

Acne Scars, CO2 Laser, Microneedling.

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BACKGROUND

Atrophic scar results from any inflammatory skin disease causing sufficient damage to epidermis and dermal collagen. The most common causes of atrophic scars are severe nodular or nodulocystic acne, infections like varicella and herpes simplex, trauma including burns and surgical procedures. Up to 90% of acne develop some scarring, but only 22% develop significant scarring. Facial scars resulting from acne are either atrophic or hypertrophic depending upon whether they are elevated or depressed in relation to the skin surface. Main morphological types of atrophic post-acne scars are icepick scars, superficial or deep boxcar scars and rolling scars.[1] Various modalities of treatments used in acne scars are microneedling or Dermaroller, dermabrasion, collagen implants, laser therapy, iontophoresis and facial resurfacing with fractional lasers.[2,3]

Fractional CO2 laser resurfacing has been used in the treatment of atrophic scars with varying degrees of success.[4,5] Microneedling or Dermaroller therapy is a new addition to the treatment armamentarium for such scars that offers a simple and reportedly effective management of these scars.

Acne scars are one of the disfiguring side effects of acne. There are several types of acne scar; pitted, depressed, nodular and cystic.

The CO2 laser has been effectively proven for the treatment of a wide range of dermatologic conditions, including treatment of acne scars. High-energy, short duration exposure to 10,600 nm CO2 laser light vaporises intra- and extracellular water causing tissue ablation. There is new collagen and elastin formation and subsequent improvement in atrophic scars. There is a new CO2 laser system with a fractional modality. It can perform fractional

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Corresponding Author:
Dr. Virendra Vijay Saoji,
Dr. Saoji's Clinic, 1st Floor,
Above Royal Medical, Rajkamal Square,
Amravati, Maharashtra-444601.
E-mail: virendrasaoji@yahoo.in
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resurfacing at depths ranging from 20 to 500 lasermine (lm) and treating 20%, 40% or 100% of the area.

Treatment with the handheld devices is known by many names like microneedling therapy, collagen induction therapy or Dermaroller therapy.[6] Dermaroller is the mechanical mode of treatment with less invasive and comparable results. Rolling with a Dermaroller (192 needles, 200 µm length and 70 µm diameter) over an area for 15 times will result in approximately 250 holes/cm and leads to neovascularisation and neocollagenesis.[7,8,9]

Figure 1. Types of Acne Scars

Goodman and Baron Qualitative Global Scarring System.[10,11]

Grade	Level of Disease	Characteristics
1.	Macular	These scars can be erythematous, hyper- or hypopigmented flat marks. They do not represent a problem of contour like other scar grades, but of colour.
2.	Mild	Mild atrophy or hypertrophy scars that may not be obvious at social distances of 50 cm or greater and maybe covered adequately by makeup or the normal shadow of shaved beard hair in men or normal body hair if extrafacial.
3.	Moderate	Moderate atrophic or hypertrophic scarring that is obvious at social distances of 50 cm or greater and is not covered easily by makeup or the normal shadow of shaved beard hair in men or body hair if extrafacial, but is still able to be flattened by manual stretching of the skin (if atrophic).
4.	Marked	Severe atrophic or hypertrophic scarring that is evident at social distances greater than 50 cm and is not covered easily by makeup or the normal shadow of shaved beard hair in men or body hair if extrafacial and is not able to be flattened by manual stretching of the skin.

MATERIALS AND METHODS

Total of 50 cases were enrolled in study carried out for 18 months in the Department of Dermatology at tertiary health centre and medical college with subsequent follow up of up to six months from December 1, 2014, to November 30, 2016.

Inclusion Criteria

- Patients willing for treatment with their signed, informed consent.
- Patients with grade 2 and 3 acne scars according to Goodman and Baron's Quantitative and qualitative scale.

Exclusion Criteria

- Patients with active acne.
- Patients with keloidal tendency.
- Pregnant women.
- Immunosuppressive diseases like HIV, diabetes, malignancy and chemotherapy.
- Concomitant isotretinoin use.
- Hypersensitivity to fractional CO2 lasers.
- Patients who lost follow-up after initial visits and patients not willing to participate in study.

Study Method- Patients in group A were treated with 4 sessions of fractional CO2 laser at monthly interval. Similarly, patients in group B will be treated with 4 sessions of

Dermaroller at monthly interval. Follow-up was done at the subsequent visits on 1, 2, 3, 4 and 6th month.

Study Tools- Baseline photographs showing all the scars to be treated, Goodman and Baron qualitative scar grading system.

Grade of Post-Acne Scarring	Level of Disease	Clinical Feature
1.	Macular	These scars can be erythematous, hyper- or hypopigmented flat marks.
2.	Mild	Mild atrophy or hypertrophy scars that may not be obvious at social distances of 50 cm or greater and maybe covered adequately by makeup or normal shadow of shaved beard hair in men or normal body hair if extrafacial.
3.	Moderate	Moderate atrophic or hypertrophic scars that is obvious at social distances of 50 cm or greater and is not covered easily by makeup or normal shadow of shaved beard hair in men or normal body hair, if extra facial, but still able to be flattened by manual stretching of the skin if atrophic.
4.	Severe	Severe atrophic or hypertrophic scarring that is evident at social distances of 50 cm or greater and is not covered easily by makeup or normal shadow of shaved beard hair in men or normal body hair, if extrafacial and is not able to be flattened by manual stretching of the skin.

Procedure-

Patients who were using any topical treatments for acne or for scars were told to stop these medications at least 1 week before the start of fractional laser treatment or Dermaroller treatment. No concomitant cosmetic procedures were allowed between the sessions and no topical drugs were prescribed except sunscreens and topical antibiotic creams in the post-procedure period. After an informed consent was taken, a baseline photograph showing all the scars to be treated was taken using standard camera angle and light settings. Then, a topical anaesthetic cream containing a eutectic mixture of topical tetracaine and lignocaine in a cream base was applied for 1 hour on the treatment area to achieve a satisfactory anaesthetic effect. After satisfactory anaesthesia was achieved, the treatment area was cleaned with a mild cleanser followed by 70% ethanol solution.

Fractional CO_2 Laser-

Fluence- 15-25 J/cm^2.
Densities- 100-150 MTZ/cm^2.
Energy- 40-45 mJ.
Ablation depth of 1.0-1.2 mm at each spot.

A single or double pass was used over each scar along with its margins. Each morphological type of scar was treated in a similar manner and the patient was advised skin cooling with icepacks for 5-10 minutes after the procedure. The laser parameters were kept identical at each visit.

Dermaroller-

The area to be treated is anaesthetised with topical anaesthesia for one hour. After preparation of the area, rolling is done 15-20 times in horizontal, vertical and oblique directions; petechiae or pinpoint bleeding, which occurs is easily controlled. After treatment, the area is wetted with saline pads. The entire procedure lasts for 15 to 20 minutes depending on the extent of the area to be treated. Four treatments with Dermaroller were given at one-month interval for mild-to-moderate acne scars.

Digital photographs were taken using identical lighting, angle and face position settings at every follow up visit. The final assessment was made by a single observer at the last followup visit, 6 months after the last laser session and a quartile grading scale was used to assess the response objectively. Adverse effects and recovery times were recorded in each session and visit. Finally, data was analysed and the results were confirmed.

RESULTS AND STATISTICS

Total of 50 patients completed the study with an average age of 23.38 years ranging from 16 to 35 years of age.

Sex ratio of male-to-female is 1:1 with 25 males and 25 females enrolled in the study.

Goodman and Barons qualitative scar grading scale at presentation and at the end of 6 months was evaluated, 52% cases in Dermaroller group and 48% patients in fractional CO2 laser group were of grade 2 and rest 48% and 52% of grade 3, respectively.

All patients in Dermaroller group improved of which 88% improved by at least one grade and 12% patients showed improvement of the scars by 2 grades in Goodman and Baron Qualitative scar grading scale.

All the patients in fractional CO2 laser group showed improvement of which 80% improved by 1 grade and rest 20% by another 2 grades in Goodman and Baron qualitative scar grading scale. 2 grade improvement was labelled as excellent response and 1 grade improvement was labelled as good response and no improvement was labelled as poor response. No cases were reported as poor response in both the treatment modalities by showing at least one grade improvement.

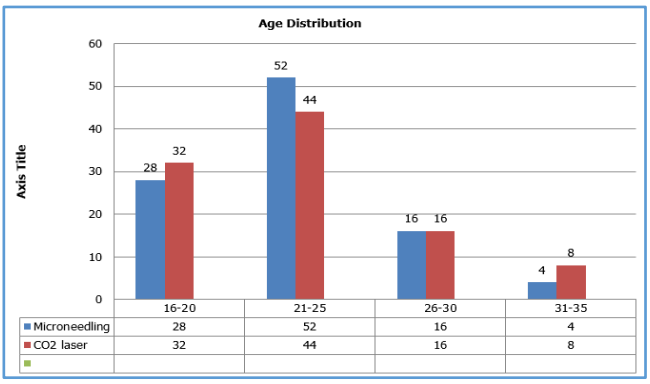
Complications observed in fractional CO2 laser were post-inflammatory hyperpigmentation in 5 cases (20%), other complication's noted were post-treatment oedema and pain in 5 cases (20%) and post-treatment erythema in 3 cases (12%) with downtime of 5-7 days, while in Dermaroller group only oedema pain and post-treatment

erythema was observed in 4 cases (16%) and 4 (16%) cases respectively and down time of 2-4 days.

Age Group in Years	CO2 Laser	Dermaroller	Percentage
16-20	8	7	30
21-25	11	13	48
26-30	4	4	18
31-35	2	1	6

Table 1. Age Distribution

The above age distribution table showed maximum patients of acne scarring in 21 to 25 years age group, 44% in CO2 laser group and 52% Dermaroller group. The overall study showed maximum patients in 21-25 age group, i.e. 48% followed by 30% in 16-20 years age group, least presentation in 31-35 years. Average mean age group 23.38 years.

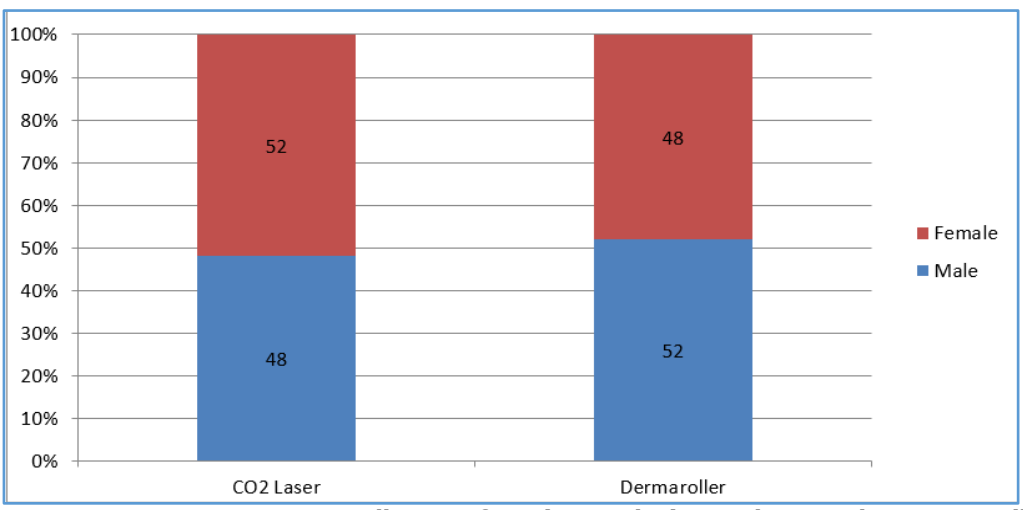


Graph 1. Age Distribution

Sex	CO2 Laser	Dermaroller
Male	12	13
Female	13	12

Table 2. Sex Distribution

The above sex distribution table showed total male patients were equal to total female patients enrolled in study with male:female ratio was 1.



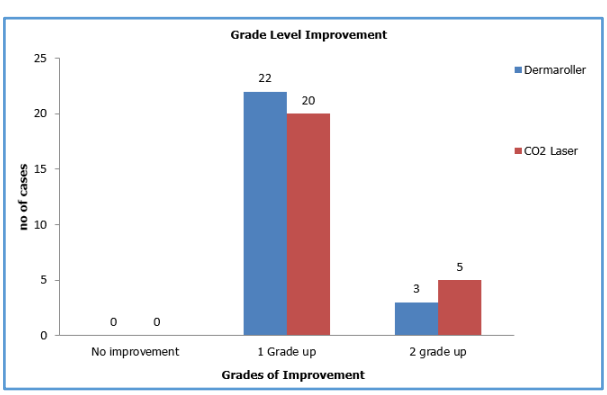
Graph 2. Post-Treatment Improvement Followup after Six Months in Goodman and Barons Qualitative Scale

Improvement	CO2 Laser	Dermaroller
No improvement	0	0
1 grade up	20 (80%)	22 (88%)
2 grade up	5 (20%)	3 (12%)

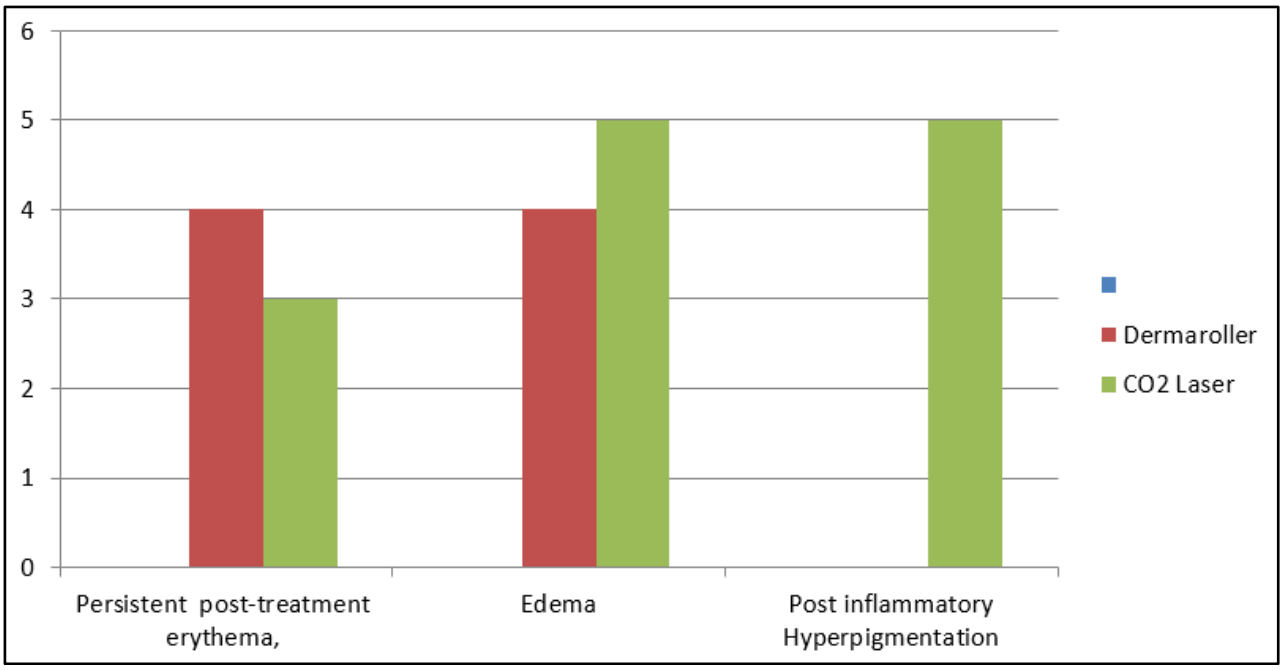
Table 3. Post-Treatment Improvement Followup After Six Months in Goodman and Barons Qualitative Scale

The above table shows 80% of CO2 laser group improvement by 1 grade and 20% showed 2 grade improvement in Goodman and Baron Qualitative acne scarring grades, while in Dermaroller group 88% improved by 1 grade and 12% improved by 2 grades, after completion of the study at final follow up at 6 months.

The improvement was rated as poor, good and excellent depending upon the change in grade of acne scars by both treating physician. An improvement by two grades was considered as excellent, 1 grade was rated as good and no upgradation on assessment was labelled as poor response.



Graph 3. Grade Level Improvement



Graph 4. Complications of the Dermaroller and Fractional CO2 Laser

Complications	Persistent Post-Treatment Erythema	Oedema	Post-Inflammatory Hyperpigmentation
Dermaroller	4	4	0
CO2 laser	3	5	5

Table 4. Complications Observed in the Study

Particulars	Baseline	After 6 months
Mean	2.52	1.36
Standard deviation	0.51	0.49
t value	15.50	

Table 5. Group A- (Fractional CO2 Laser) Comparison of Changes in Goodman and Barron Qualitative Acne Scarring Grading Scale

The above table of comparison shows mean of acne scarring grade at baseline and follow-up after fractional CO2 laser treatment. The mean acne scarring grade at baseline was 2.52 ± 0.51 and it was reduced after 6 months to 1.36.

The reduction of mean acne scarring grade on follow up was found to be statistically significant (P <0.05).

Particulars	Baseline	After 6 months
Mean	2.48	1.24
Standard deviation	0.51	0.43
t value 14.20		

Table 6. Group B Dermaroller Comparison of Changes in Goodman and Baron Qualitative Acne Scarring Grading Scale

The above table of comparison shows mean of acne scarring grade at baseline and followup after Dermaroller treatment. The mean acne scarring grade at baseline was 2.48 ± 0.51 and it was reduced after 6 months to 1.24.

The reduction of mean acne scarring grade on follow up was found to be statistically significant (P<0.05).

	Particulars	Baseline	After 6 Months	Difference
Group A fractional CO2 laser	Mean	2.52	1.36	1.16
	Standard deviation	0.51	0.49	0.02
	Paired 't' test	2.50		
Group B microneedling with Dermaroller	**Particulars**	**Baseline**	**After 6 Months**	
	Mean	2.48	1.24	1.24
	Standard deviation	0.51	0.43	0.08
	Paired 't' test	1.30		

Table 7. Intergroup Comparison

After comparing both the groups, the difference in mean acne scarring grade was 1.16 ± 0.02 in group A and 1.24 ± 0.08 in group B on completion on followup at 6 months.

Dermaroller therapy was applied to 25 patients of grade 2 and grade 3, of which 13 of grade 2 and 12 of grade 3 and 25 patients were treated with fractional CO2 laser 12 cases of grade 2 and 13 cases of grade 3.22 (88%) cases in Dermaroller group improved by at least one grade as good outcome and 3 (12%) cases by two grades improvement as excellent in terms of Goodman and Baron qualitative score.

Fractional CO2 laser group showed good improvement of which 20 (80%) improved by 1 grade and rest 5 (20%) by another 2 grades, i.e. excellent outcome in terms of Goodman and Baron qualitative scar grading scale. 2 grade improvement was labelled as excellent response and 1 grade improvement was labelled as good response and no improvement was labelled as poor response This study demonstrated the efficacy of fractional CO2 laser treatments for mild-to-moderate acne scarring. Participants returned back to work after 4.64 days in fractional CO2 laser group and 2.64 days in Dermaroller group as it has lesser downtime.

DISCUSSION

Acne scarring occurs subsequent to visible resolution of deep inflammation. Scarring may occur regardless of the severity of acne. Although, acne scarring is likely to be associated more often with nodulocystic acne, it may occur in cases with only superficial forms of acne as well, especially when effective treatment is delayed. A study showed that approximately 16% of patients with acne seek proper treatment and among those seeking such help, 74% wait greater than 12 months, 12% wait for 6 to 12 months, 6% wait for 6 months and only 7% wait for less than 3 months to be seen professionally for therapy of their acne.

We studied fractional CO2 laser and microneedling with Dermaroller for acne scars to treat atrophic acne scars in patients of Indian ethnicity with Goodman and Baron's global qualitative acne scarring system grade 2 and 3. Estimation of improvement with Goodman and Baron's global qualitative acne scarring system showed (100%) improvement in their scars with no failure rate. The treatment was well tolerated with transient side effects such as mild erythema, oedema, pain, post-inflammatory hyperpigmentation and track marks of the device. Dermaroller therapy was applied to 25 patients of grade 2 and grade 3 of which 13 of grade 2 and 12 of grade 3 and 25 patients were treated with fractional CO2 laser 12 cases of grade 2 and 13 cases of grade 3. 22 (88%) cases in Dermaroller group improved by at least one grade as good outcome and 3 (12%) cases by two grades improvement as excellent in terms of Goodman and Baron qualitative score. While fractional CO2 laser group showed good improvement of which 20 (80%) improved by 1 grade and rest 5 (20%) by another 2 grades, i.e. excellent outcome in terms of Goodman and Baron qualitative scar grading scale. 2 grade improvement was labelled as excellent response and 1 grade improvement was labelled as good response and no improvement was labelled as poor response This study demonstrated the efficacy of fractional CO2 laser treatments for mild-to-moderate acne scarring. Participants returned back to work after 4.64 days in fractional CO2 laser group and 2.64 days in Dermaroller group as it has lesser downtime.

Adverse effects seen were not significant and none of the enrolled patients had any long-term or permanent side effects from the procedure. However, there is certainly some downtime associated with fractional CO2 laser resurfacing as patients do experience crusting for a few days after the procedure. This crusting makes it impossible for patients to resume their normal work for a few days after each laser session.

Figure 2. Co2 Laser Therapy

Figure 3. Dermaroller Therapy

CONCLUSION

It is important to realise that a typical patient has scars of different morphological types and grades and it is difficult to treat all these scar types satisfactorily with a single treatment option and multiple techniques are required. However, of all the treatment options available to treat post-acne scars, fractional photothermolysis is probably the only monotherapy that offers the highest degree of scar amelioration and patient satisfaction. Considering the recovery time, adverse effects and outcome, fractional CO2 laser can be an alternative treatment technique for acne scar. In summary, Dermaroller is a simple, inexpensive office method of treatment for management of facial acne scars with relatively less downtime and fewer complications as compared to fractional CO2 laser with larger downtime with severe complications of post-inflammatory hyperpigmentation. It would be difficult to conclude

considering the small sample size of the study, there is a need to have a large sample-sized study with a relatively long-term follow up of the patients focusing different types of scars and duration.

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