



TOPICAL TAZAROTENE 0.1% VS FRACTIONAL CO₂ LASER IN TREATING ATROPHIC ACNE SCARS

Dermatology

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ABSTRACT

Background: Scarring remains a frequent and challenging outcome of acne vulgaris. Among topical treatments, retinoids like tazarotene have demonstrated the ability to stimulate collagen production via fibroblast activation. Fractional CO₂ laser treatment addresses acne scars by generating microscopic zones of dermal injury interspersed with untreated skin. **Objective:** This study aims to compare the efficacy and tolerability of 0.1% topical tazarotene gel with fractional CO₂ laser therapy. **Methodology:** A single-center, parallel-group clinical trial was conducted at the dermatology outpatient clinic of a tertiary care hospital in India. Twenty-six participants aged 18 to 40 years with acne vulgaris scarring were enrolled. The two treatment modalities under investigation were 0.1% tazarotene gel and fractional CO₂ laser therapy. Acne scarring was assessed both qualitatively and quantitatively using Goodman and Baron grading system. **Results:** In the tazarotene group, the median baseline scar score of 7 [6–8] dropped to 3 [3–5] ($p=0.000$). In the laser group, scores decreased from 8 [6–8] to 2 [2–3] ($p=0.000$). The laser group exhibited a significantly greater improvement in scar scores at four months compared to the tazarotene group (2 [2–3] vs. 3 [3–5], $p=0.008$). **Conclusion:** The study concludes that fractional CO₂ laser therapy is a highly effective and well-tolerated treatment option for acne-related scarring yet topical tazarotene 0.1% cream is an effective and affordable treatment option.

KEYWORDS

Fractional CO₂ laser, Retinoids, Tazarotene gel, Acne scars.

INTRODUCTION

Acne vulgaris is a widespread chronic inflammatory skin condition affecting over 80% of adolescents and young adults (Fife D 2011). Factors such as lesion severity and delayed treatment contribute to scarring, which impacts around 95% of patients (Layton et al 1994) and ice pick scars being the most common, accounting for 60–70% of cases (Pavlidis et al 2017). Individuals who do not receive effective treatment within the first three years of acne onset have a 1.6 to 2.8 times higher risk of scarring than those who are treated earlier (Dreno 2014).

Retinoids like tazarotene have demonstrated the ability to stimulate dermal collagen production by acting on fibroblasts (Fisher et al 2000). A study by Tanghetti et al 2010 found that tazarotene 0.1% cream is more effective and better tolerated than adapalene 0.3% gel in reducing acne scarring. Afra et al 2019 showed notable improvement in both the quantitative and qualitative Goodman and Baron scores using tazarotene 0.1% gel and microneedling, highlighting the therapeutic potential of topical tazarotene.

Currently, fractional laser therapy is considered one of the most effective treatments for acne scars. CO₂ lasers offer dual benefits: promoting wound healing and enhancing the production of myofibroblasts and extracellular matrix proteins, including hyaluronic acid (Majid et al 2014, Petrov et al 2016). Ablative lasers have also shown effectiveness, though results vary (Sardana et al 2012). Clinical and histological data suggest improvements in acne scarring ranging from 46% to 80%, with an average efficacy of 66.8% (Sardana et al 2012, Waibel et al 2009). Therefore, the current study aims to assess the efficacy and tolerability of topical tazarotene 0.1% gel in comparison with fractional CO₂ laser therapy, which serves as the benchmark due to its proven effectiveness and minimal side effects in treating acne scars. We hypothesise that efficacy and tolerability of topical tazarotene 0.1% gel is comparable to fractional CO₂ laser therapy.

MATERIALS AND METHOD

Study Design and Participants

A single-center, active-controlled, parallel-group trial was conducted at the dermatology outpatient department of a tertiary care hospital over four months, from January to April 2025. Ethical approval was obtained from the Institutional Ethics Committee of JJM Medical College and Hospital, Davangere. A total of 73 patients aged 18–40 years presenting with acne vulgaris were screened, and 26 individuals who met the inclusion criteria were enrolled. Exclusion criteria included patients with active acne, keloids or hypertrophic scars, keloidal tendency, vitiligo, history of herpes infections, pregnancy or lactation, and known hypersensitivity to tazarotene.

Sample Size Estimation

Sample size was determined using G*Power software version 3.1.9.2 (Universität Düsseldorf, Germany). With an anticipated 20% dropout rate over four months and significance levels set at $\alpha = 0.05$ and $\beta = 0.20$, 26 participants were enrolled (13 per group).

Method of Data Collection

All the selected patients underwent dermatological assessments included skin type, predominant scar type (ice pick, boxcar, or rolling), and scar severity grading as per the Goodman and Baron system. Qualitative grading – Macular pigmented scars as grade 1, mild atrophic scars invisible from a social distance of 50 cm or more as grade 2, moderately visible scars as grade 3, and scars resistant to skin stretching as grade 4.

Quantitative grading was based on both the type and number of scars. Macular and mild atrophic scars a score of 1; moderate and severe atrophic scars, 2 and 3 respectively; and hyperplastic scars, 4. These values were multiplied by factors reflecting scar counts: 1 for 1–10 scars, 2 for 11–20 scars, and 3 for more than 20.

A computer-generated randomization process was used by a person not involved in the study to assign participants randomly to treatment groups.

Topical Application of Tazarotene 0.1% gel (Group A)

Patients were instructed to apply a pea-sized amount of gel in a thin layer to the affected half of the face every evening. Moisturizer was allowed during the day if dryness developed; however, other facial medications were restricted.

Fractional CO₂ Laser Therapy (Group B)

Before laser application, the treatment area was cleansed, and a topical anesthetic (EMLA cream – lidocaine and prilocaine) was applied for 45 minutes, then removed with sterile water. Eye shields were used for protection. Laser treatment was delivered using the FUTURA RF 50 (RF excited) fractional CO₂ laser 10600nm, in normal mode at 30–60 mJ/cm² point energy, 1–1.5 msec pulse duration, and 0.8 mm spacing. Cooling with ice was done pre- and post-treatment. Sunscreen was applied afterward, and patients were advised to avoid sun exposure for 4–5 days. The laser parameters remained consistent across all sessions.

After each session, patients rated their pain using a 10-point VAS scale (0 = no pain; 10 = severe pain) and assessed improvement as fair (up to 60%), good (30–60%), or excellent (>60%).

Participants were followed monthly over four months. Photographs were taken at each visit using standardized lighting and positioning. Tolerability was also evaluated by documenting symptoms such as erythema, peeling, dryness, and burning.

Statistical Analysis

Data were analyzed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Qualitative data were presented as frequencies and percentages, while quantitative data were expressed as mean, SD or median with interquartile range. For categorical data chi-square or Fisher's exact test was applied. For continuous data Mann-Whitney U test or Friedman's test was applied. The significant level was set $p < 0.05$.

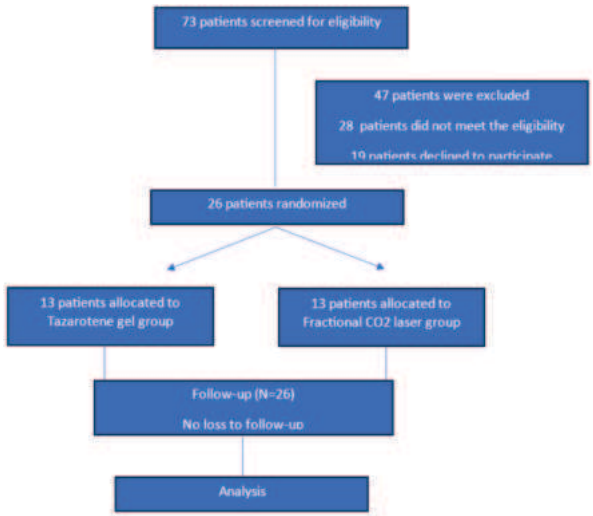


Figure 1: Flow Diagram

RESULTS

The present study involved 26 patients with acne scars. Of these, 13 patients were treated with 0.1% tazarotene gel (Group A), while the remaining 13 received fractional CO₂ laser therapy (Group B). The average age of participants in Group A and Group B was 27.53 ± 6.89 and 27.46 ± 5.95 years, respectively ($p = 0.976$). In Group A, there were 7 (53.8%) female and 6 (46.2%) male participants, whereas Group B included 8 (61.5%) females and 5 (38.5%) males ($p = 0.691$). Skin phototype III was the most common in both groups, seen in 8 participants (61.5%). The mean duration of acne was 4.76 ± 2.16 years in Group A and 5.15 ± 1.81 years in Group B ($p = 0.628$). Grade IV acne scarring was observed in 9 patients (69.2%) in Group A and 8 patients (61.5%) in Group B (Table 1).

Table 1 Demographic Characteristics of Study Participants

Variables	0.1% tazarotene gel (N=13)	Fractional CO ₂ laser therapy (N=13)	p-value
Age in years Mean $\pm$ SD	27.53 $\pm$ 6.89	27.46 $\pm$ 5.95	0.976
Gender			
Male	6 (46.2%)	5 (38.5%)	0.691
Female	7 (53.8%)	8 (61.5%)	
Skin phototype			
Type I	1 (7.7%)	0	0.753
Type II	2 (15.4%)	3 (23.1%)	
Type III	8 (61.5%)	8 (61.5%)	
Type IV	2 (15.4%)	2 (15.4%)	
Severity of scarring (Goodman and Baron)			
Grade 1	0	0	0.680
Grade 2	0	0	
Grade 3	4 (30.8%)	5 (38.5%)	
Grade 4	9 (69.2%)	8 (61.5%)	
Duration of acne in years	4.76 $\pm$ 2.16	5.15 $\pm$ 1.81	0.628

In the tazarotene group, a visible improvement in scar severity was noted from baseline to the fourth month, with 76.9% of patients showing improvement. However, 3 patients (23.1%) showed no change ($p = 0.208$). In the fractional CO₂ laser group, 92.3% of patients exhibited statistically significant improvement, with only one case (7.7%) showing no change ($p = 0.006$). Although both groups experienced improvement from baseline to follow-up, the intergroup difference was not statistically significant ($p = 0.157$) (Table 2).

Table 2 Comparison Changes in Severity of Grading in Response to Treatment at Various Time Interval

Groups	Grades	At baseline	At 2 months	At 4 months	p-value
0.1% tazarotene gel (N=13)	Grade 1	0	1 (7.7%)	1 (7.7%)	0.208
	Grade 2	0	2 (15.4%)	4 (30.8%)	
	Grade 3	4 (30.8%)	5 (38.5%)	5 (38.5%)	
	Grade 4	9 (69.2%)	5 (38.5%)	3 (23.1%)	
Fractional CO ₂ laser therapy (N=13)	Grade 1	0	2 (15.4%)	6 (46.2%)	0.006
	Grade 2	0	4 (30.8%)	3 (23.1%)	
	Grade 3	5 (38.5%)	3 (23.1%)	3 (23.1%)	
	Grade 4	8 (61.5%)	4 (30.8%)	1 (7.7%)	
p-value		0.680	0.657	0.157	

Both treatment groups showed statistically significant reductions in quantitative acne scores from baseline to the fourth month. In the tazarotene group, the median baseline score of 7 [6–8] decreased to 3 [3–5] ($p = 0.000$). In the laser group, the median score dropped from 8 [6–8] to 2 [2–3] ($p = 0.000$). While baseline scores were comparable, the laser group demonstrated a significantly greater reduction in acne scores at the fourth month compared to the tazarotene group (2 [2–3] vs. 3 [3–5], $p = 0.008$) (Table 3).

Table 3 Comparison of Changes in Severity of Quantitative Grading at Various Time Interval Between Groups

Time interval	0.1% tazarotene gel (N=13) Median[IQR]	Fractional CO ₂ laser therapy (N=13) Median[IQR]	p-value
At baseline	7[6-8]	8[6-8]	0.650
At 2 months	5[4.5-6]	6[4-6]	0.935
At 4 months	3[3-5]	2[2-3]	0.008
p-value	0.000	0.000	



Group A: Before Treatment and After 4 Months Photographs.



Group A: Before Treatment and After 4 Months Photographs.



Group B: Before Treatment and After 4 Months Photographs.

Regarding pain levels in the fractional CO₂ laser group, the median pain score was 5 [5–6] after the first session, which declined to 4 [4–5.5] after the second session, further to 2 [2–3.5] after the third, and finally to 0 [0–1.5] by the last session. The reduction in pain over time was statistically significant ($p = 0.000$) (Table 4).

Table 4 Comparison of Median Pain Scores After Fractional CO₂ Laser Therapy Throughout the Sessions

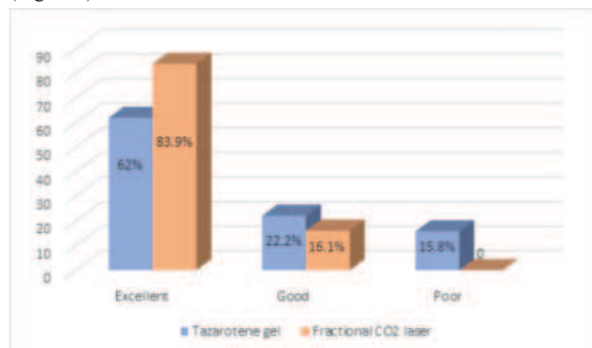
VAS cores	At 1st session	At 2nd session	At 3rd session	At 4th session	p-value
Median [IQR]	5[5-6]	4[4-5.5]	2[2-3.5]	0[0-1.5]	0.000

In terms of side effects, 5 patients (38.5%) in the tazarotene group reported dryness, while 3 (23%) experienced scaling. In the laser group, all patients developed erythema immediately post-treatment, which subsided within 72 hours, and 4 patients (30.8%) experienced edema. No hyperpigmentation was observed in either group (Table 5).

Table 5 Frequency of Side Effects Among Study Participants in Both the Groups

Side effects	0.1% tazarotene gel (N=13)	Fractional CO ₂ laser therapy (N=13)
Dryness	5 (38.5%)	0
Scaling	3 (23%)	0
Erythema	0	13 (100%)
Edema	0	4 (30.8%)
Hyperpigmentation	0	0

In the tazarotene group, 62% of patients reported an excellent improvement following treatment, whereas in the fractional CO₂ laser therapy group, 83.9% of patients rated their improvement as excellent (Figure 2).

**Figure 2: Patients Satisfaction at the End of Treatment**

DISCUSSION

To our knowledge, this is the first study directly comparing these two interventions. Findings indicated that both treatments yielded comparable improvements in acne scar severity, both qualitatively and quantitatively, by the end of the study.

Praiser et al (2008) compared 0.1% tazarotene cream with 0.1% adapalene gel, showing reductions in acne lesions and better tolerability in terms of erythema and scaling. Thiboutot et al. (2008) found that once-daily use of both 0.3% adapalene and 0.1% tazarotene gel offered comparable outcomes in acne management. Leyden et al. (2002) concluded that 0.1% tazarotene gel had superior efficacy, tolerability, and a cost-effective alternative to tretinoin 0.1% microsphere gel. Our findings support the once-daily use of tazarotene gel, demonstrating significant lesion reduction with good patient tolerance. Its therapeutic effects are likely due to its ability to regulate cell differentiation, reduce hyperproliferation, and exert anti-inflammatory effects—mechanisms that target the inflammatory processes involved in acne.

Fractional CO₂ lasers have long been used in dermatology and cosmetic treatments. They work by generating precise micro-injuries in the skin, initiating a photothermal reaction as laser beams interact with water in skin tissue. This leads to controlled cell damage and the stimulation of collagen production as part of the skin's repair process (Ptaszek et al 2025). In our study, there was a notable decline in quantitative acne scores—from a median baseline of 8 [6–8] to 2 [2–3] by the fourth month. Similar outcomes were observed in studies by Hedelund et al 2012, who reported significant improvement in skin texture after three monthly laser sessions. Majid et al 2014, also found the fractional CO₂ laser to be effective, particularly for treating rolling and superficial boxcar scars, with minimal side effects. Ahmed et al 2012, observed improvement in over 71% of patients, including complete scar resolution in two cases. Walgrave et al 2009, similarly confirmed the treatment's efficacy, reporting mild to moderate enhancements in scar appearance.

In our study, tazarotene was generally well tolerated. These outcomes align with findings of Afra et al 2019, where fewer than one-third of participants reported such side effects. Feldman et al 2013, noted that severe reactions were rare, with only 2.6% of subjects discontinuing treatment due to localized irritation. Notably, none of the participants in our trial discontinued tazarotene therapy.

In the fractional CO₂ laser group, all patients experienced erythema, and four (30.8%) developed edema. These side effects were consistent with previous reports by Sanad et al 2022, Majid et al 2014, and Hedelund et al 2012. The observed reactions are likely due to the increased vascular response associated with the inflammatory process triggered by the laser. Most patients experienced procedural pain lasting up to 72 hours. Therefore, careful pre-procedural planning and adherence to aftercare guidelines are essential to minimize complications.

Our study population primarily included individuals with Fitzpatrick skin type III. A uniform treatment approach using the same laser fluence and density was applied across all scar types and depths. Approximately 83.9% of participants showed excellent improvement based on the quartile grading scale, consistent with findings reported by Majid et al 2014.

However, the study has limitations, including a small sample size and a short follow-up period, which restrict generalization of the results. Further research involving larger, multi-center trials with extended observation periods is necessary. Nevertheless, treatment adherence was strong, with no dropouts and direct compliance assessment via a checklist.

CONCLUSION

Our findings indicate that fractional CO₂ laser therapy is an effective and well-tolerated option for treating post-acne scars. Overall, approximately 84% of patients rated the treatment as excellent yet topical tazarotene 0.1% cream is an effective and affordable treatment option.

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