International Journal of Medicine
pISSN 1468-3814 | eISSN 2667-7008
https://theinternationalmedicine.com/

Original Researcher Article *DOI: 10.61336/im/26-08-64*

Efficacy and Safety of Fractional Carbon Dioxide (CO_2) Laser in Benign Skin Lesions.

Dr. Bharath Bangera N J[1], Dr. Lalith S[2], Dr. Samhitha S R[3*]

[1]*Assistant Professor, Department of Dermatology, Subbaiah Institute of Medical Sciences, Shivamogga, Karnataka, India*
[2]*Assistant Professor, Department of Dermatology, Subbaiah Institute of Medical Sciences, Shivamogga,Karnataka,India*
[3]*Assistant Professor, Department of General Medicine, Subbaiah Institute of Medical Sciences, Shivamogga, Karnataka,India*

Correspondence:
Dr Samhitha S R
Assistant Professor, Department of General Medicine, Subbaiah Institute of Medical Sciences, Shivamogga, Karnataka,India.

Received: 15-06-2026
Revised: 25-06-2026
Accepted: 22-07-2026
Published: 08-08-2026

Abstract

Background: Benign skin lesions cause significant cosmetic disfigurement and patient anxiety. Fractional carbon dioxide (CO_2) laser has emerged as the gold standard in ablative laser treatment, yet data on its efficacy and safety for Indian skin types remain limited. **Objectives:** To evaluate the efficacy and safety profile of fractional CO_2 laser in the treatment of benign skin lesions. ***Methods:*** A prospective interventional study was conducted on 100 patients at VIMS, Ballari (March 2021 – February 2022). All patients underwent fractional CO_2 laser ablation. Efficacy was assessed using the Global Improvement Scale (GIS) and patient satisfaction using the Patient Satisfaction Score (PSS) at 1, 4, and 12 weeks. ***Results:*** 87% of patients achieved near-total improvement (GIS Grade 4). Complete lesion removal was achieved in 95% of cases. Recurrence rate was 6.32%. Late complications included post-inflammatory hyperpigmentation (21%) and scarring (8.4%). 70% of patients rated satisfaction as very good to excellent. ***Conclusion:*** Fractional CO_2 laser ablation is effective, safe, and well-tolerated for a wide spectrum of benign skin lesions, including darker skin phototypes.

Keywords: Benign skin lesions, Fractional CO_2 laser, Global Improvement Scale, Acrochordons, Post-inflammatory hyperpigmentation, Fitzpatrick skin type.

This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC-BY) license (http://creativecommons.org/licenses/by/4.0/).

INTRODUCTION

Benign skin lesions are non-cancerous growths that may be self-reported by patients or discovered during routine dermatological examination.

These lesions can accumulate over a lifetime and, though medically innocuous, often cause significant cosmetic disfigurement and psychological distress.

Traditional management options include cryotherapy, electrocautery, radiofrequency ablation (RFA), and surgical excision. Over the past decade, laser technology has transformed dermatological practice.

The carbon dioxide (CO_2) laser, operating at 10,600 nm, is considered the gold standard among ablative lasers.

It employs selective photothermolysis to target water-containing tissue with controlled vaporization, providing a bloodless field, minimal thermal spread, reduced patient discomfort, and rapid recovery.

Fractional delivery further improves outcomes by limiting thermal injury to fractionated microthermal zones, leaving surrounding tissue intact and accelerating healing. Despite widespread use, systematic safety and efficacy data for Indian skin types (Fitzpatrick III–V) remain sparse. This study addresses that gap.

Objectives

1. To evaluate the efficacy of fractional CO_2 laser ablation in the treatment of various benign skin lesions.
2. To assess the safety profile, including immediate and late complications, of fractional CO_2 laser treatment.

MATERIALS AND METHODS

Study Design and Setting

A hospital-based prospective interventional study was conducted in the Department of Dermatology, Venereology and Leprosy, VIMS, Ballari, Karnataka, India, from March 2021 to February 2022.

Ethical committee clearance was obtained and written informed consent was obtained from all participants.

Sample Size and Patient Selection

Sample size was calculated using $N = Z^2P(1-P)/d^2$, based on data from Cho SB et al. (2011), with 42.9% marked improvement as reference, 95% confidence level, and absolute precision of 0.107. Minimum required size was 83; 100 patients were enrolled for improved statistical power.

Inclusion criteria: patients ≥18 years of either sex with benign skin lesions who consented to the procedure.

Exclusion criteria: active cutaneous infection in the treatment area, history of keloid/hypertrophic scar formation, isotretinoin use within 6 months, pregnancy or lactation, or uncontrolled diabetes mellitus.

Laser Equipment and Procedure

All patients were treated with the FUTURA RF 50 CO_2 Laser (Dermaindia) — a metal-tube RF-excited fractional laser (10,600 nm, spot size 0.1 mm, 50W maximum). CW mode: 2–7 W. Pulse mode: 8–22 W, 0.8–1 ms pulse duration, 50 Hz frequency. Treatment areas were prepared with povidone-iodine; EMLA cream applied under occlusion 60 minutes pre-procedure; local lignocaine infiltration where required.

Outcome Assessment

Follow-up was at 1, 4, and 12 weeks post-procedure (telephonic follow-up used for COVID-19-restricted patients). Objective assessment: Global Improvement Scale (GIS) — Grade 0 (no improvement) to Grade 4 (near-total improvement). Subjective assessment: Patient Satisfaction Score (PSS) at 12 weeks — 0 (none) to 8 (excellent).

Statistical Analysis

Data analysed using IBM SPSS v25.0. Categorical variables expressed as frequencies and percentages. Chi-square test for associations; $P < 0.05$ considered statistically significant.

RESULTS

Demographic Profile

100 patients enrolled (52 male, 48 female; ratio 1.08:1). Age: 49% aged 18–29 years, 35% aged 30–45, 11% aged 46–59, 5% aged ≥60 years. Comorbidities: 90% none, 7% diabetes mellitus, 3% hyperlipidemia.

Table 1: Demographic and Clinical Characteristics

Parameter	Category	n	%
Age (years)	18–29	49	49%
	30–45	35	35%
	46–59	11	11%
	≥60	5	5%
Sex	Male	52	52%
	Female	48	48%
Comorbidities	None	90	90%
	Diabetes Mellitus	7	7%
	Hyperlipidemia	3	3%
Fitzpatrick Skin Type	Type III	33	33%
	Type IV	63	63%
	Type V	4	4%

Lesion Characteristics

Most common site: face (66%), followed by neck (19%) and periorbital region (21% of all lesions). Duration: ≥1 year in 60%, <1 year in 34%, since birth in 6%. Dominant skin type: Fitzpatrick IV (63%), III (33%), V (4%).

Table 2: Distribution of Benign Skin Lesions

Type of Lesion	n	%
Acrochordons	24	24%
Dermatosis Papulosa Nigra (DPN)	13	13%
Melanocytic Nevus	11	11%
Syringoma	11	11%
Pyogenic Granuloma	7	7%
Colloid Milia	7	7%
Seborrheic Keratosis	6	6%
Verruca (Warts)	6	6%
Linear Verrucous Epidermal Nevus	5	5%
Xanthalesma	3	3%
Fibroma	2	2%
Others (1% each)	5	5%
Total	100	100%

Treatment Response and Outcomes

CW mode: 61%; pulse mode: 39%. Complete lesion removal: 95 patients (95%). Of those, 6 patients (6.32%) had recurrence during follow-up; 89 (93.68%) remained recurrence-free.

Table 3: Global Improvement Scale and Patient Satisfaction Score

Scale	Grade/Score	Description	n	%
GIS	Grade 4	Near-total improvement	87	87%
	Grade 3	Marked improvement	6	6%
	Grade 2	Moderate improvement	2	2%
	Grade 1	Minimal improvement	3	3%
	Grade 0	No improvement	2	2%
PSS	8 (Excellent)		10	10%
	6 (Very Good)		60	60%
	4 (Good)		22	22%
	2 (Mild)		4	4%
	0 (None)		4	4%

Complications

Table 4: Immediate and Late Complications

Complication	Type	n	%
Post-operative pain	Immediate	10	10%
Watery discharge	Immediate	10	10%
Erythema	Immediate	9	9%
No immediate complication	Immediate	71	71%
Post-inflammatory hyperpigmentation	Late	20	21%
Scarring	Late	8	8.4%
No late complication	Late	67	70.5%

Of the 20 patients who developed PIH, 70% had Fitzpatrick skin type IV and 30% had type III. Five patients were lost to follow-up.

Illustrative Cases

Representative before-and-after clinical photographs are presented below for the major lesion types treated in this study. All images were captured under standardised lighting conditions at the VIMS Dermatology procedure room.

Acrochordons (Skin Tags)

Complete removal was achieved in all 24 cases using CW mode. Patient satisfaction was excellent (33.3%) or very good (66.7%). No recurrence was observed at 12 weeks.

Figure 1: Acrochordon before and after CO_2 laser ablation

Seborrheic Keratosis

Near-total improvement was achieved in 5/6 patients (83.3%); 1 patient showed moderate improvement. Side effects: erythema and PIH. No recurrence at 12 weeks.

Figure 2: Seborrheic Keratosis before and after CO_2 laser ablation

Dermatosis Papulosa Nigra (DPN)

All 13 patients with DPN achieved near-total improvement using pulse mode. Side effects: erythema and PIH. No recurrence at 12 weeks.

Figure 3: Dermatosis Papulosa Nigra (DPN) before and after CO_2 laser ablation

Colloid Milia

Near-total improvement in 6/7 patients (85.7%); mild improvement in 1 patient. Side effects: pain, PIH, and scarring. No recurrence at 12 weeks.

Figure 4: Colloid Milia before and after CO_2 laser ablation

Syringoma

Near-total improvement in 10/11 patients (90.9%); marked improvement in 1 patient. Side effects: erythema, watery discharge, and PIH. Recurrence in 1 patient at 12 weeks.

Figure 5: Periorbital Syringoma before and after CO_2 laser ablation

Melanocytic Nevus

Near-total improvement achieved in all 11 patients using CW mode. Side effects: erythema, watery discharge, and PIH. No recurrence at 12 weeks.

Figure 6: Melanocytic Nevus before and after CO_2 laser ablation

Xanthalesma Palpebrarum

Marked improvement in 2/3 patients (66.7%); moderate improvement in 1 patient. All 3 patients had associated hyperlipidemia. Recurrence occurred in all 3 cases within 1 month, underscoring the need for concurrent lipid management.

Figure 7: Xanthalesma Palpebrarum before and after CO_2 laser ablation. Note: Recurrence observed in all cases at 1 month; associated hyperlipidemia was present in all patients

Linear Verrucous Epidermal Nevus (LVEN)

Near-total improvement in 2/5 patients (40%), marked improvement in 2 patients (40%), and no improvement in 1 patient (20%). CW mode used in all cases. Side effects included pain, watery discharge, PIH, and scarring.

Figure 8: Linear Verrucous Epidermal Nevus (LVEN) before and after CO_2 laser ablation

Pyogenic Granuloma

Near-total improvement in all 7 patients. CW mode alternating with pulse was used to control bleeding. Side effects: pain, watery discharge, and PIH. No recurrence at 12 weeks.

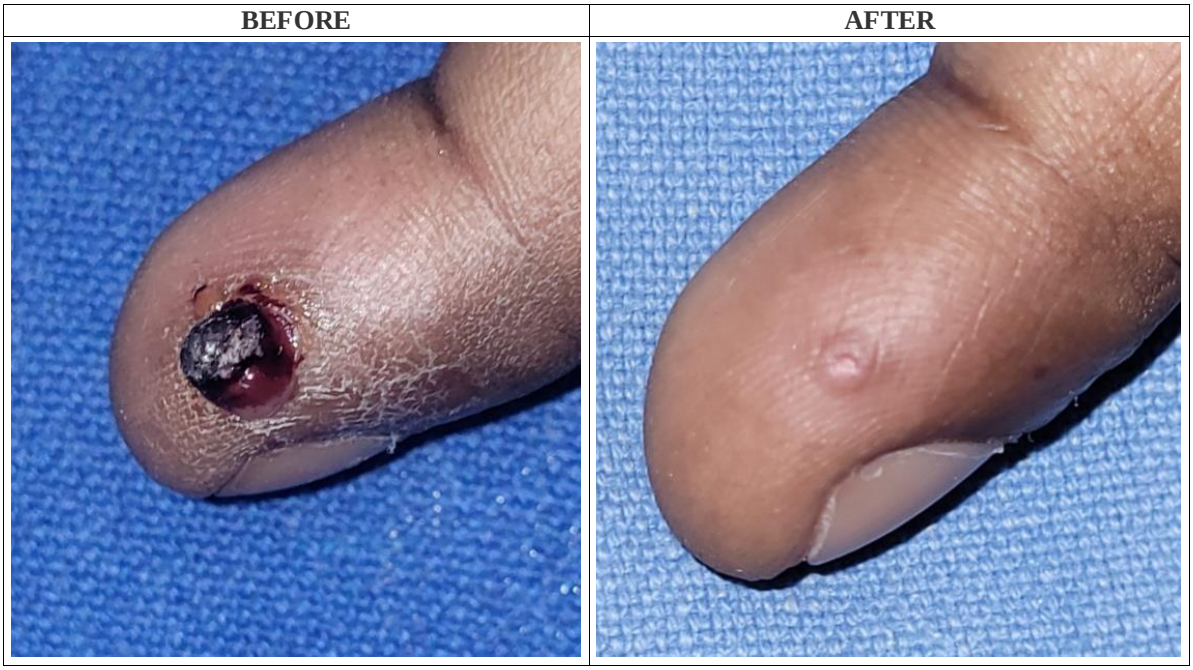

Figure 9: Pyogenic Granuloma before and after CO_2 laser ablation

Fibroma

Near-total improvement in both patients with fibroma using CW mode. Side effect: PIH. No recurrence at 12 weeks.

Figure 10: Fibroma before and after CO_2 laser ablation

Trichoepithelioma

The single patient with trichoepithelioma achieved near-total improvement using CW mode with no side effects or recurrence at 12 weeks.

Figure 11: Trichoepithelioma before and after CO_2 laser ablation

Post-Inflammatory Hyperpigmentation (Complication)

Post-inflammatory hyperpigmentation was the most common late complication, observed in 20 patients (21%). It was more prevalent in Fitzpatrick skin type IV (70% of PIH cases). The image below demonstrates PIH following CO_2 laser ablation of syringoma.

Figure 12: Post-inflammatory hyperpigmentation (PIH) following CO_2 laser ablation of syringoma

Recurrence — Sebaceous Hyperplasia

The single patient with sebaceous hyperplasia showed moderate improvement but developed recurrence at 4 weeks post-procedure. This case illustrates the challenge of treating sebaceous hyperplasia, consistent with its known tendency to recur, as also reported by Kim JH et al.

Figure 13: Recurrence after CO_2 laser ablation of Sebaceous Hyperplasia (pre-treatment, 1 week, 1 month post-procedure)

DISCUSSION

This study demonstrates that fractional CO_2 laser ablation is a highly effective modality for treating a wide spectrum of benign skin lesions. The overall near-total improvement rate of 87% and complete removal rate of 95% compare favourably with existing literature.

Sarvepalli et al. (2020) in a split-face study comparing CO_2 laser versus RFA in 70 patients reported near-total improvement in only 38.57% with CO_2 laser. The superior outcomes in our study may reflect lesion-specific laser parameter optimisation and single-session management in most cases.

Acrochordons (24%) were the most common lesion, all achieving near-total improvement. DPN (13%) showed 100% near-total improvement, consistent with Bruscino et al. (2014). For syringomas, near-total improvement in 90.9% exceeded the 8.6% reported by Cho et al. (2011), possibly reflecting differences in laser settings and lesion depth.

Xanthalesma showed 100% recurrence at 1 month, with all patients having associated hyperlipidemia — underscoring the need for concurrent lipid management alongside procedural treatment. This is consistent with findings by Esmat et al. (2014), who reported 15% recurrence in hyperlipidaemic patients.

The PIH rate (21%) exceeded that of Sarvepalli et al. (7.14%), likely reflecting our cohort's predominantly Fitzpatrick type IV skin. Of PIH cases, 70% occurred in type IV patients, highlighting the need for proactive post-procedural photoprotection and topical depigmenting agents in darker phototypes.

Limitations include a 12-week follow-up period, which may underestimate late recurrence, and 5 patients lost to follow-up due to COVID-19 pandemic restrictions.

CONCLUSION

Fractional CO_2 laser ablation is a safe, effective, and well-tolerated modality for the management of a broad spectrum of benign skin lesions. Complete removal in a single session was achieved in 95% of patients with a low recurrence rate of 6.32%. Global improvement was near-total in 87% of cases, and 70% of patients reported very good to excellent satisfaction. Complications were predominantly mild and transient. Particular attention to post-procedural care is warranted in patients with darker skin phototypes to minimise PIH risk. Larger, multicentre studies with longer follow-up periods are recommended to validate these findings.

REFERENCES

1. Krupa Shankar D, Chakravarthi M, Shilpakar R. Carbon dioxide laser guidelines. J Cutan Aesthet Surg. 2009;2:72-80.
2. Omi T, Numano K. The Role of the CO2 Laser and Fractional CO2 Laser in Dermatology. Laser Ther. 2014;23:49-60.
3. Cho SB, Kim HJ, Noh S, Lee SJ, Kim YK, Lee JH. Treatment of syringoma using an ablative 10,600-nm carbon dioxide fractional laser: a prospective analysis of 35 patients. Dermatol Surg. 2011;37:433-438.

4. Sarvepalli A, Sudhakar M, Rajesh V. A Split face study of CO2 fractional laser vs radiofrequency cautery for the destruction of various benign non-infectious epidermal and appendageal tumors of the skin. Ann Trop Med & Public Health. 2020;23:SP231925.
5. Zaresharifi S, Robati RM, Dadkhahfar S et al. Efficacy and safety of cryotherapy, electrodesiccation, CO2 laser, and Er:YAG laser in the treatment of seborrheic keratosis. Dermatol Ther. 2021;34:e15083.
6. Bruscino N, Conti R, Campolmi P et al. Dermatosis Papulosa Nigra and 10,600-nm CO2 laser, a good choice. J Cosmet Laser Ther. 2014;16:114-116.
7. Esmat SM, Elramly AZ, Abdel Halim DM et al. Fractional CO2 laser is an effective therapeutic modality for xanthelasma palpebrarum: a randomized clinical trial. Dermatol Surg. 2014;40:1349-1355.
8. Ozaki M, Suga H, Eto H et al. Efficacy of serial excisions of melanocytic nevi on the face using a carbon dioxide laser: a cosmetic point of view. Aesthetic Plast Surg. 2014;38:316-21.
9. Raulin C, Greve B, Hammes S. The combined continuous-wave/pulsed carbon dioxide laser for treatment of pyogenic granuloma. Arch Dermatol. 2002;138:337.
10. Kim JH, Park HY, Lee WS, Kang JS. Sebaceous hyperplasia effectively improved by the pin-hole technique with squeezing. Ann Dermatol. 2013;25:257-8.
11. Boroujeni NH, Handjani F. Cryotherapy versus CO2 laser in the treatment of plantar warts: a randomized controlled trial. Dermatol Pract Concept. 2018;8:168-173.
12. Sinha K, Mallipeddi R, Sheth N, Al-Niaimi F. Carbon dioxide laser ablation for trichoepitheliomas: The largest reported series. J Cosmet Laser Ther. 2018;20:9-11.