

## Original Research Article

# Complications of fractional ablative carbon dioxide laser in various aesthetic procedures: a retrospective study

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## ABSTRACT

**Background:** Though fractionated CO<sub>2</sub> laser technology resurface patients with a lower rate of complications than non-fractionated ablative laser treatment, adverse effects can still occur even with the best technology.

**Methods:** In this retrospective study we evaluated 65 patients for early and delayed complications after laser treatment with Sellas Cis-FI™ fractional CO<sub>2</sub> laser system of wavelength 106400 nm for various aesthetic indications over the period of 12 months from October 2017 to September 2018. Follow up was done for the period of 2 months after the last session to determine the nature and frequency of various complications. Patient's subjective assessment of the complications was recorded in the form of patient subjective score (PSS) which ranged from 1 to 10.

**Results:** In the current study, the most common aesthetic indication for fractional CO<sub>2</sub> laser was post acne scarring (38.4%). The most common early side effects reported were erythema (95.38%) and burning sensation (92.30%) after the procedure. Post procedural dryness and edema was seen in 72.3% and 69.23% patients. Among the delayed complications most frequently observed was persistent erythema (46.15%) followed by post inflammatory hyperpigmentation (44.61%).

**Conclusions:** Though fractional CO<sub>2</sub> laser is relatively a safe procedure, undesirable sequelae may still occur as a result of inappropriate selection of laser parameter, injudicious patient selection, inadequate preoperative counselling and suboptimal postoperative care. Dermatologist should keep the possibility of all the side effects that can occur after fractional CO<sub>2</sub> laser and must take appropriate precautions during the procedure to avoid them.

**Keywords:** Microthermal zones, Fractional lasers, Ablative lasers

## INTRODUCTION

Fractional ablative CO<sub>2</sub> laser represents one of the significant advances in aesthetic dermatology and has become the treatment of choice for various aesthetic indications. It has offered a bridge between the frankly full ablative lasers and the milder non-ablative lasers. It creates microscopic thermal zones which unlike frankablation are surrounded by normal undamaged skin so that re-epithelization could be achieved sooner.<sup>1</sup> Though fractional lasers represent a better standard of

safety than the traditional lasers but they are not without side effects. Most complications arise due to poor intraoperative technique- over stacking of passes, higher than recommended energy or higher density (number of microscopic thermal zones per unit area), failure to adhere to a strict postoperative recovery regimen, mechanical status of the laser, Fitzpatrick skin phototype-dark skin type has higher risk for post inflammatory hyperpigmentation (PIH) after laser therapy.<sup>2-4</sup> With this perspective, the present study was conducted in an attempt to explore both early and delayed complications

associated with the use of fractional ablative CO<sub>2</sub> laser in various aesthetic indications.

## METHODS

In this retrospective study design, after ethical approval from local institute ethical committee, we evaluated 65 patients for early and delayed complications after laser treatment with Sellas Cis-Fl™ fractional CO<sub>2</sub> laser system of wavelength 106400 nm for various aesthetic indications over the period of 12 months from October 2017 to September 2018 at Sri Guru Ram Das Institute of Research and sciences, Amritsar.

## Procedure

Total number of 4 laser sessions with appropriate parameters (Table 1) was given at an interval of 4 weeks in between the sessions. Follow up was done for the period of 2 months after the last session to determine the nature and frequency of various complications. Patient's subjective assessment of the complications was recorded in the form of patient subjective score (PSS) which ranged from 1 to 10, 10 representing most severe form of the side effect observed. Results were analyzed using statistical package for social.

**Table 1: Parameters selected for various aesthetic indications.**

S. No.	Indication	Area	Mode	Pattern	PPA	No. of passes	Energy level (millijoules)
1	Acne scars	Face	Stamping	Scatter	49/64	Single	25-50
2	Stretch marks	Body	Stamping+moving	Random	49/64 100/169	Single	25-30
3	Skin rejuvenation	Face	Moving	Scatter	100/69	Single	5-8
4	Keloids	Body	Stamping	Random	64/81	1-2 passes	25-40
5	Traumatic scars	Body	Stamping	Continuous	64/81	1-2 passes	25-40
6	Xanthelasma	eyelids	Stamping	Scatter	49	1-2 passes	45-50

### Inclusion criteria

Patients of age group of 20-40 years and Fitzpatrick skin type IV-VI (Asian population) with following indications for fractional CO<sub>2</sub> laser as acne scars, striae distensae, skin rejuvenation, keloids, traumatic scars and xanthelasma were included.

### Exclusion criteria

Patients with active local or systemic infections, connective tissue disorders, patients who are pregnant and active dermatoses like psoriasis or vitiligo were excluded.

## RESULTS

Out of 65 patients, there were 42 females and 23 males with female: male 1.8: 1. Mean age of study population was 26.45±3.67 years. Most of the patients belonged to Fitzpatrick skin type IV (66.15 %) followed by skin type V (18.46%) (Table 2).

In the current study, the most common aesthetic indication for fractional CO<sub>2</sub> laser was post acne scarring (38.4%). The most common early side effects reported were erythema (95.38%) and burning sensation (92.30%) after the procedure. Post procedural dryness and edema was seen in 72.3% and 69.23% patients (Table 3).

Among the delayed complications most frequently observed was persistent erythema (46.15%) followed by post inflammatory hyperpigmentation (44.61%) (Table 4).

**Table 2: Baseline characteristics of study population.**

Demographic characteristics	
Female: male	1.8: 1
Mean age (in years)	26.45±3.67
Fitzpatrick skin type	No. of patients
IV	43
V	12
VI	10
Indications	
Acne scars	25
Traumatic scar	4
Stretch marks	13
Keloids	5
Skin rejuvenation	14
Xanthelasma	4

**Table 3: Early complications after fractional ablative CO<sub>2</sub> laser.**

Early complication	N (%)	Mean PSS
Erythema	62 (95.38)	7.23±1.23
Burning	60 (92.30)	8.34±1.89
Edema	45 (69.23)	5.34±0.67
Dryness	47 (72.30)	6.89±1.22
Scabbing	47 (72.30)	4.32±0.87
Pruritus	19 (29.23)	4.98±1.23
Petechiae	3 (4.61)	7.89±1.03
Urticaria	2 (3.07)	6.03±1.99
Reactivation of herpes simplex	2 (3.07)	5.05±1.23

PSS: Patient's subjective score.

**Table 4: Delayed complications after fractional ablative CO<sub>2</sub> laser.**

Delayed complication	N (%)	PSS
<b>Persistent erythema</b>	30 (46.15)	8.98±1.98
<b>Post inflammatory hyperpigmentation</b>	29 (44.61)	9.87±0.23
<b>Post inflammatory hypopigmentation</b>	4 (6.15)	7.98±2.98
<b>Milia</b>	19 (29.23)	5.90±2.23
<b>Acne aggravation</b>	13 (20.0)	7.90±2.10

PSS: Patient's subjective score.

**DISCUSSION**

Though fractional lasers have achieved the goal of developing a system with minimal complications and efficiency as good as ablative lasers, but they are not completely devoid of side effects. The spectra of complications vary from minor post-operative erythema to persistent dyschromia. The majority of complications associated with laser resurfacing are linked to the depth of cutaneous damage, which in turn is linked to the excessive number of passes, higher density (the number of microscopic thermal lesions per area) and fluency used.<sup>4,5</sup> In the present study immediate side effects like post-operative erythema and burning sensation were reported in most of the patients. Such minor side effects are inevitable due to increased blood flow during the inflammatory response to laser therapy, However persistent erythema lasting for upto a month after last the session has been observed in 46.15% of our patients (Figure 1). In a study done by Metelista et al reported incidence of persistent erythema was slightly lower (25%) patients with average duration of 3.5 months.<sup>5</sup> High incidence (29.2%) of pruritus and scabbing (73.2%) was seen in our patients owing to dryness, crust formation and irritation induced by laser (Figure 2). These side effects were easily manageable with cold compresses, anti histaminics and emollients. It is advisable to withhold application of topical corticosteroids after laser therapy to avoid secondary infections. Similar high incidence of pruritus (90%) has been reported in various studies.<sup>3-6</sup> Post laser edema was seen in 69.23% of the patients which resolved on its own in a week or 2 without any sequel. Reactivation of herpes labialis was reported in 3.07% of the patients. In a study done by Metelista et al herpetic infections occurred after fractional ablative laser and non-ablative laser-based resurfacing in 0.3-2% of cases. Nonetheless, infection rates increased to 2-7% when traditional ablative lasers were used.<sup>5</sup> Course of antivirals started 2 days before and continued for 7-10 days after the laser resurfacing can prevent reactivation of herpes simplex infections in patients with history of recurrent herpes.<sup>6</sup> Delayed complications like acne aggravation or milia formation was observed in between 2-8 weeks after laser resurfacing in 20% and 29.9% of patients respectively, which was slightly higher than in other studies.<sup>5-8</sup>

Aberrant follicular re-epitheliazation during healing process can contribute to it (Figure 3).



**Figure 1: Persistent erythema after fractional CO<sub>2</sub> laser.**



**Figure 2: Scabbing after fractional CO<sub>2</sub> laser.**



**Figure 3: Acne aggravation and milia after fractional CO<sub>2</sub> laser.**

Non comedogenic and gel based sunscreen and emollients were given in such patients with short course of azithromycin. Oral and topical retinoid were avoided due to reported risk of hypertrophic scarring in damaged skin.<sup>9</sup> Most feared complication after laser therapy in a

skin of color is post inflammatory hyperpigmentation which was seen in 30% of patients. Incidence upto as high as 65% has been reported in literature.<sup>4,6,10</sup> Hence appropriate selection of laser parameters is of paramount importance. Kono et al assessed the complications of different energy and density settings of fractional CO<sub>2</sub> laser.<sup>6</sup> Pain, edema, erythema and PIH were more common in patients treated with higher energy and density settings. Various authors recommend adequate detanning before laser resurfacing and use of lower fluencies in patients of skin of color.<sup>11</sup> Various risk factors associated with PIH are tanned skin, operative errors such as higher densities, short pulse interval, higher fluency and overlapping or more no. of passes.<sup>5,12</sup> In present study, patients with PIH were managed conservatively with sunscreen and depigmenting agents such as triple combination creams. In 6.15% of the patients instead of hyperpigmentation, post inflammatory hypopigmentation was seen. Fractional lasers are certainly capable of damaging the skin enough to cause excessive fibrosis and disruption of melanogenesis, resulting in hypopigmentation.<sup>13</sup> In various studies, reported incidence of post laser hypopigmentation was 6-20%.<sup>5,7,14,15</sup> In order to avoid hypopigmentation, the procedure must be carried out within cosmetic units. It is also important to highlight that the mandibular line is very susceptible to hypopigmentation and scars, so it must always be treated with a single laser pass only.<sup>8</sup>

## CONCLUSION

When used according to appropriate parameters, fractional ablative CO<sub>2</sub> laser resurfacing is relatively safe procedure than traditional CO<sub>2</sub> lasers but is not completely devoid of complications.

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