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Complications in Cosmetic Dermatology

Crafting Cures



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Foreword
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3
CHAPTER

Protocols and Complications in Fractional Carbon Dioxide in the Management of Facial Scar

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❑ INTRODUCTION

Carbon dioxide (CO_2) laser has more thermal effect (coagulation) than evaporation (ablation) compared to erbium doped yttrium-aluminum-garnet (Er:YAG) laser, meaning more chances of complication like postinflammatory pigmentation, persistent erythema, and scarring. Carbon dioxide laser was an absolute contraindication for darker skin types until recently its fractional mode of beam delivery was introduced. High wattage devices delivering entire energy within very small fraction of time (UltraPulse) increased safety profile of CO_2 lasers to considerable extent (Box 1). Scars are collection of collagen that is abnormal in quality, quantity, and direction. Fractional columns of CO_2 laser induces partial denaturation of collagen inducing formation of new collagen fibers from surrounding tissue. Scars are less vascular and poor healer tissue. So, balancing injury pattern of laser to the healing potential of the tissue is the key in avoiding complications of CO_2 lasers. This chapter discusses safe protocol of using fractional CO_2 laser in Indian skin mainly facial scars. Laser treatable scars and scar-like conditions have been mentioned in box 2.

Box 1: Golden triad of safety in fractional carbon dioxide laser

- UltraPulse profile on high wattage machine
- Low density
- High fluence

❑ FRACTIONAL CARBON DIOXIDE LASER

Fractional lasers are the advancement in mode of energy delivery. In 2004, Manstein et al. introduced the concept of fractional photothermolysis.[1] Solid cylindrical beam of laser is fractionated into tiny microbeams. Instead of a wide column of bulk heating, discrete vertical columns of ablation and coagulations are created with normal tissue in between. This slight change in parameter will make a tremendous alteration in wound healing profile. Secondary intention healing is converted into primary intention healing which is faster, safer, and more restorative to normal anatomy.[2]

❑ SAFETY AND RISK PARAMETERS IN FRACTIONAL CARBON DIOXIDE LASER

Newer CO_2 fractional lasers allow variation of the thermal damage zones while others allow

Box 2: Laser treatable scar and scar-like conditions[3,4]

- Macular (pigmented or erythematous) scars
- Atrophic scars
  - Ice pick scars
  - Boxcar scars
    - Chickenpox scars
    - Acne scars
  - Rolling scars (valley scars)
  - Shallow atrophic scars
    - Stretchable
    - Nonstretchable
- Hypertrophic scars
  - Popular acne scars
  - Phymas
  - Surgical scars
  - Postaccidental scars
  - Postburn scars
- Contractures
  - Postburn contractures
- Keloids
- Stretch marks
  - Striae rubra
  - Striae nigra
  - Striae alba
- Morphea
- Fine wrinkles, lines, and solar elastosis

superficial and deeper penetration with a single scan.[1]

Width of Fractional Column

Width of fractional column should be minimal. There are two patterns of beams. Deep narrow fractional lasers (Deep FX on UltraPulse) have width of 100 μ and depth 1,000–2,000 μ. Second pattern is wide superficial with 1.1 mm (1,100 μ) width and 100 μ depth (Active FX on UltraPulse).

Ratio of Ablation to Coagulation

Carbon dioxide laser act by evaporation of water molecule in the target tissue. If energy is delivered in sufficiently short duration of time, cells get plumed along with vapors at temperature greater than 100°C and is called ablation. In this case of evaporation, there is no transfer of heat to deeper layer. If energy delivery is slower, tissue gets heated, coagulated, and sometimes charred and called lateral thermal damage that may cause risk of scarring and hyperpigmentation.

Ratio of Width to Depth of Microthermal Zone

For scar treatment, fractional laser beam should penetrate deeper without lateral thermal damage. Only UltraPulse beam profile and very high wattage can achieve this ablation column profile (Figure 1).

Pulse Structure

UltraPulse width of pulse duration is superior to superpulse mode (Figure 2). Continuous wave CO_2 lasers are no more used in cosmetic indications.

Fluence

Fluence is energy density, i.e. joules per square centimeter (J/cm^2). Highest possible fluence will reach maximum depth in one shot. In lower power devices, it is achieved by stacking of low fluence pulses that increases thermal component.

Density of Microthermal Zones per Square Centimeter

Safety of fractional laser depends upon normal tissue in between vertical laser beams. So higher the density, higher is risk of complications. In Indian skin, lowest possible density with highest possible fluence is the safety parameter. Higher density can be achieved by multiple passes of above safe, less

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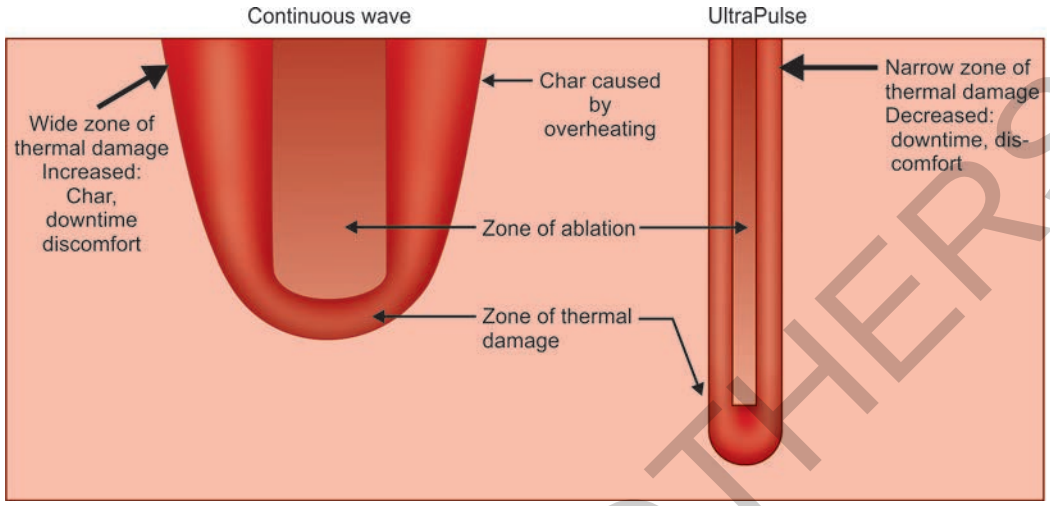


Figure 1: Ratio of depth to width of fractional column is key parameter of fractional laser safety.

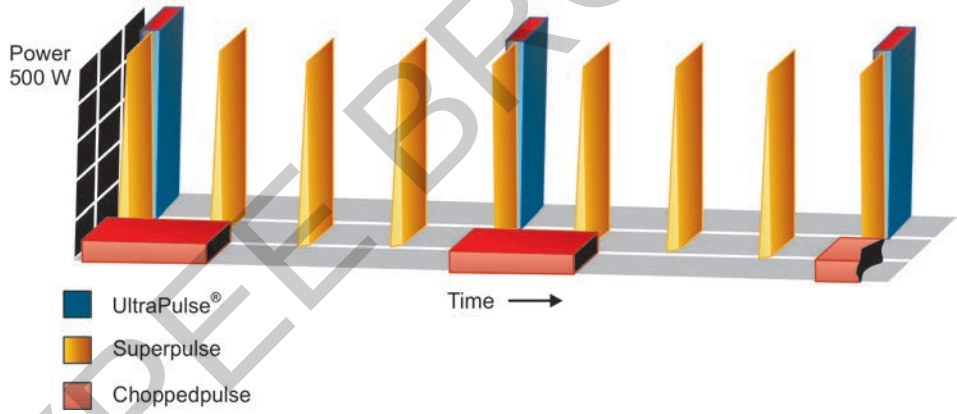


Figure 2: Pulse profiles: chopped pulse versus superpulse versus UltraPulse.

dense parameters. It is well established that postinflammatory hyperpigmentation (PIH) is proportional with how much basal cell layer is ablated. So multiple passes or higher density is associated with PIH.[5]

Repetition Rate or Stacking

In low power machines, high fluence is adjusted by stacking multiple pulses at the same spot. Additional stacking is highly risky in CO_2 laser in skin of color. Any fluence that is not able to raise tissue temperature to 100°C will induce coagulation of tissue protein and not ablation. Repeat pass on coagulated protein will end up charring. Char is carbon. Carbon has heat holding capacity till 600°C and called heat sink. This scenario at tissue level is worse than thermal cautery and will negate all benefits of lasers.

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Hydration of Tissue

Safety in CO_2 laser is evaporation of tissue water and risk is heating of tissue water less than 100°C. Hydrated tissue improves evaporation and dry tissue leads to desiccation and charring. Laser tissue interaction works for safety only in adequately hydrated tissue.

Appendage Density in Treatment Area

Treatment area to be treated with fractional CO_2 laser is classified as "appendage rich" versus "appendage poor" instead of historical acral versus centrofacial classification. Appendage rich area, like face, has better healing and safety profile compared to appendage poor acral area. Atopic and ichthyotic skin is again appendage poor and a poor healer.

❑ WHICH PATIENTS WE SHOULD AVOID?

Literature mentions many scenarios as contraindications for use of CO_2 lasers. Those hold true mainly for surgical mode and continuous wave types of CO_2 lasers. Fractional mode and UltraPulse structure of pulse width has converted most of these absolute contraindications into relative ones.

- Recent tan is relative contraindication as it may cause PIH. A gap of at least 10 days from recent sun exposure is needed. A topical bleaching regimen is recommended by many but not proven to prevent PIH. Patient with outdoor lifestyle and lower socioeconomic status are often not aware that their level of sun exposure is high. Author has devised a test called "Sleeve test" to know the contrast between skin tone of covered skin and uncovered skin (Figure 3)
- Active herpes simplex or other infection on face



Figure 3: Sleeve test to judge level of tanning. Higher contrast indicates higher risk in the candidate.

- Severe active acne in treatment area: few lesions may not warrant postponing the treatment
- Appendage poor skin: acral areas are usually appendage poor. Facial skin, if dry and atopic, is considered appendage poor. Patient in figure 4 shows a case of melanocytic nevus treated with multiple passes of Active FX uneventfully. Similar protocol in similar lesion on acral area with poor appendage density ended up in hypertrophic and keloid formation that took several months of treatment to flatten (Figure 5)
- Pregnancy: though it is not an absolute contraindication, it is preferable to avoid these cases till the child birth for practical purposes
- Isotretinoin: concurrent use or use in past is described as a contraindication in various literature. In author's personal experience with more than 100 patients on isotretinoin, treated with fractional CO_2 laser, no adverse event like abnormal scarring or altered wound healing was observed in any case. However, patients are best advised not to be on isotretinoin till further scientific evidence is available

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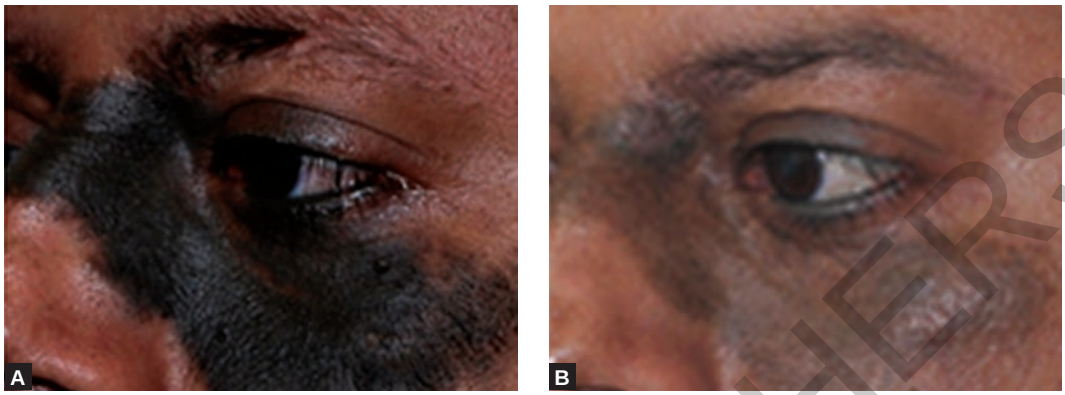


Figure 4: High level of safety in appendage rich skin: high fluence UltraPulse Active FX on face. **A,** Before; **B,** after.



Figure 5: High risk profile in appendage poor skin resulting in hypertrophic scarring.

- Keloids: It is a relative contraindication. Treatment of keloids with fractional CO_2 laser when used in combination with fractional drug delivery of triamcinolone and 5-fluorouracil is found to be safe
- Resurfacing with fractional CO_2 laser is contraindicated in the presence of ectropion, prior blepharoplasty of the lower lid or significant lower lid laxity
- Unrealistic expectations: patients with body dysmorphophobia and unrealistic expectations should be avoided.

❑ TECHNIQUE AND PROTOCOLS FOR FACIAL ACNE SCARS (BOX 3)

Before Procedure

- Stop isotretinoin, if any, 2 weeks before the day of treatment
- Stop topical antiacne comedolytics two days before the treatment
- Check for recent suntan
- A bleaching regimen with double or triple combination is commonly practiced that does not guarantee avoidance of PIH

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Box 3: Laser techniques in acne scar treatment

- Single tier technique: Deep FX or Active FX
- Two tier technique: Total FX
- Three tier technique: Total FX with scar shouldering
- Four tier technique: Total FX with scar shouldering with high fluence Deep FX at base of the scar

Note: All laser acne scar treatments should be combined with subcision on same day or on another day.

- Check for active herpes simplex labialis
- Preprocedure standardized photographs
- Anesthesia: Topical anesthesia with lidocaine and prilocaine (EMLA) cream under occlusion or nerve blocks in case of extensive scars
- Tumescent local anesthesia can be used on full face with or without nerve block while treating extensive scars or when multiple passes of laser is required. Face typically requires 100–300 mL of tumescent fluid and a higher concentration of lignocaine and adrenaline compared to tumescent fluid of liposuction
- Give a loading dose of amoxycillin and clavulanic acid antibiotic capsule and tablet lorazepam in case of extensive scars.

The Procedure

- Remove topical anesthesia on a smaller area. Clean the area with saline to remove cream remnant that may block optical penetration of laser light
- Keep smoke evacuator ready
- Protective eye wear for patient and operator. Face is prepared with surgical scrubbing
- Keep skin hydrated with wet gauze with normal saline
- Deep fractional laser is used as first pass with 10% overlap
- Superficial fractional laser: Active FX is used as last pass
- Shouldering is described under chicken-pox scars
- Reinforcement of anesthesia: if only topical anesthesia is used it wears off during first pass. A 1:5 diluted lignocaine solution can be massaged on laser treated area to reinforce numbness. This is adaptation of principle of "fractional drug delivery"
- Parameters used for acne scar are as follows:
  - Deep FX 20–35 mJ, 5% density, no stacking, two passes; second pass 45° to first pass
  - Active FX 150 mJ, density 3–4 on dial of 10, no stacking, up to 350 Hz.

Postprocedure

- Cold wet compress to reduce edema
- Healing serum or a plain white petroleum jelly to be applied on face frequently in a day in postoperative 3–4 days. It is widely believed that wet healing (closed bandage) is better than dry healing. White petroleum jelly is a nice adaptation of wet dressing
- No soap to wash face; use mild cleansers to wash face three times a day. Alternatively, water with little quantity of acetic acid (white vinegar) can be used for frequent face wash in first few days. Basic principle is maintaining pH of skin to acidic side prevents bacterial colonization. It should be kept on mind that soaps are mostly alkaline
- No topical antibiotic ointment is recommended as it may cause sensitization and future allergy to antibiotic molecule. Oral antibiotic like amoxycillin and clavulanic acid with nonsteroidal anti-inflammatory drugs twice daily for 3–5 days are given

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- No steroid cream is recommended postoperatively to avoid sensitization. A single dose of prednisolone 0.5–1 mg/kg in two divided doses can be given (20 mg stat and 20 mg after 12 h)
- What to expect? Immediately after treatment face turns red. From the next day, small scabs start forming and face turns brown to black. These scabs usually fall on 5^{th}–7^{th} day. After scab falls, slight erythema is seen. At this stage, a moisturizer and sunscreen is added. A bleaching regimen with hydroquinone and with or without steroid is added after the 7th day of procedure
- Protocol: How many sessions and how frequently? With aggressive parameters, three sessions will yield 50–75% improvement in moderate to severe acne scars and more than 75% improvement if combined with subcision and scar shouldering.

❑ TECHNIQUE AND PROTOCOLS FOR CHICKENPOX SCARS

A three tier technique combining shouldering of scar border, subcision, and Deep FX of scar and surrounding area is employed. Scar shouldering is done with either 1 mm surgical tip of the CO_2 laser or in UltraPulse Active FX spot size 2 with fluence 150–200 mJ and 300 Hz. Base of scars is marked with surgical markers after surgical preparation of face. This 0.5–1 mm spot is moved on and around the edge of the deep chickenpox scar. The ablated tissue is cleared with wet gauze before second pass. A total of two to three passes of Active FX at edge of chickenpox scar are given. A pass with Deep FX at fluence 35–40 mJ is attempted at base of scar. The same technique can be used in deep rolling acne scars as well.

❑ TECHNIQUE AND PROTOCOLS FOR HYPERTROPHIC SCARS

Hypertrophic scars differ from keloids in one aspect that they do not grow beyond the limit of original injury. Hypertrophic scars have clumped bundles of nonpliable collagen arranged in haphazard pattern as against regular parallel arrangement of normal collagen. Aim of laser treatment to induce thermal injury to existing collagen leading to denaturalization that stimulates production of new collagen that is arranged in normal and more organized way. Postsurgical scars, postaccidental scars, and postburn hypertrophic scars are amenable to fractional CO_2 laser. Challenge in treating hypertrophic scar is reaching depth of 2–4 mm without extending lateral thermal damage. Most of low wattage CO_2 lasers achieves depth by means of pulse stacking at cost of lateral bulk heating. Only very high wattage device with UltraPulse configuration can maintain very high depth to width ratio.

It is worth remembering that scar is poorly vascularized and is a poor healer. Rox Anderson, opines that "Burn scars are caused due to injury that extends beyond healing capability by primary intention". Using another heat injury to heal the scar itself is a risky proposition. Ablation remaining fractional is the key factor and any aggressiveness in parameters will pose the advantage of fractional laser."

In SCAAR FX technology, depth can be achieved up to 4,000 μ (4 mm) without significant lateral thermal damage. SCAAR FX has made significant impact on outcome of hypertrophic scar laser treatment. Less density and very high power is the key here again. SCAAR FX at density of 3–5% and fluence of 60–120 mJ is used in scars with thickness of 2–4 mm. A 3% density with two or three passes in different directions to have more coverage than high density single pass.

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Pre- and post-treatment protocol remains same except tumescent local anesthesia to topical anesthesia is preferred. Analgesia remains for hours after procedure in case of tumescent anesthesia. Three sessions is the minimum protocol while some patients may require more sessions depending upon thickness of scars and parameters used and adjuvant use of intralesional triamcinolone injections. Table 1 summarizes the typical efficacy of fractional CO_2 laser in burn scars at various intervals during treatment. The thickness and textural improvement is more than 75% in three sessions while color match to surrounding skin is less than 75%.[6]

❑ TECHNIQUE AND PROTOCOLS FOR KELOIDS

Keloids are different from hypertrophic scar. Keloids extend and infiltrate beyond the limits of original boundaries (Figure 6). There are many treatments commonly tried for keloids, none of them is uniformly effective. Now it is commonly believed that keloids are treated by combinations of various treatments. Fractional CO_2 lasers are used in combinations of pressure and intralesional triamcinolone with variable results. Deep narrow fractional CO_2 laser (SCAAR FX) to treatment protocol improves results significantly. Six to ten treatment sessions alternated or combined with intralesional injections and pressure gives impressive results.

❑ TECHNIQUE AND PROTOCOLS FOR MORPHEA

Morphea is an inflammatory skin condition leading to scarring changed in dermis and subcutaneous structure. Treatment combining anti-inflammatory treatments like excimer or ultraviolet B phototherapy, collagen remodeling therapy like fractional CO_2 laser and collagen stimulating therapy like platelet rich plasma results in significant improvement in early cases of morphea and moderate improvement in severe cases of morphea.

❑ COMPLICATIONS AND HOW TO HANDLE THEM

Common complications of fractional CO_2 laser (Table 2) and measures to handle them are discussed below.

Pain, Syncope

Carbon dioxide laser is painful and require anesthesia. Topical anesthesia is usually enough. For hypertrophic scars where deeper penetration of laser is expected, field block or tumescent anesthesia is required. Performing procedure in lying down position and painless anesthesia technique can eliminate chances of vasovagal syncope.

Postinflammatory Hyperpigmentation

This is the most common complication of CO_2 laser treatment in type IV–VI skin. Almost all

TABLE 1: Efficacy of fractional carbon dioxide in postburn scarring

Point of assessment	Average VAS for scar thickness	VAS for surface flattening	VAS for color match
After one session	2.14	2.1	0
After two sessions	2.94	3.15	0
1 month after three sessions (the final assessment)	3.13	3.7	1.65
3 months after three sessions (the final assessment)	3.47	3.85	2.89

VAS, visual analog scale.

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Figure 6: A case of hypertrophic keloidal scar of acid burn of 6–8 mm thickness, completely flattened with combination protocol. Similar results are expected in chest keloids.

TABLE 2: Common complications in fractional carbon dioxide laser

Complications	Frequency	Severity
Pain	Common	–
Syncope	Common	–
Postinflammatory hyperpigmentation	Common	–
Postinflammatory hypopigmentation	Uncommon	Temporary
Erythema	Common	Temporary
Injury to deeper structure like panniculitis	Common with SCAAR FX	–
Infection	Uncommon	–
Reactivation of herpes simplex	Common	Fairly common in susceptible individuals
Reactivation of vitiligo	Uncommon	Fairly common in susceptible individuals
Reactivation of psoriasis	Uncommon	–
Reactivation of inflammatory disorders like lichen planus	Uncommon	–

Continued

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Continued

TABLE 2: Common complications in fractional carbon dioxide laser

Complications	Frequency	Severity
Contact dermatitis	Uncommon	–
Worsening of scar	Uncommon	Severe
Nonhealing ulcer	Common in contractures	Severe
Keloid formation	Uncommon	In susceptible individuals

patients will experience at least a transient phase of mild hyperpigmentation. Mild PIH should be considered as normal postprocedural sequel and not a complication. Darker patients, recent suntan, poor sun protection postoperatively, dry and appendage poor skin along with device parameters like non-UltraPulse profile, very high fluence, high density, pulse stacking will contribute to PIH. Preprocedural bleaching regimen using hydroquinone with and without steroids is recommended by many but with no evidence of prevention of PIH in scar treatment (Figure 7). Box 4 discusses measures to be taken to prevent or minimize PIH.

Postinflammatory Hypopigmentation and Erythema

It is an uncommon complication in Indian patients as against described commonly in literature for skin type V-VI patients (Figure 8). Immediately after falling of scabs skin shows erythema and hypopigmentation that slowly converts to skin color or PIH (Figure 9). Persistent erythema is rare and can be treated with vasoconstrictor gel or silicone gel application. Persistent erythema is better treated with vascular specific intense pulsed light (IPL) with filter at 540 or 570 mm. Newer duel filter IPL with filters at 550 and 600 nm (Dye VL on Harmony Alma) are very effective in managing persistent erythema.

Infection

Bacterial infections and fungal infections are uncommon after fractional lasers. An intense erythema and persistent burning in treated area is a sign of infection. A broad spectrum oral antibiotic cover is recommended when

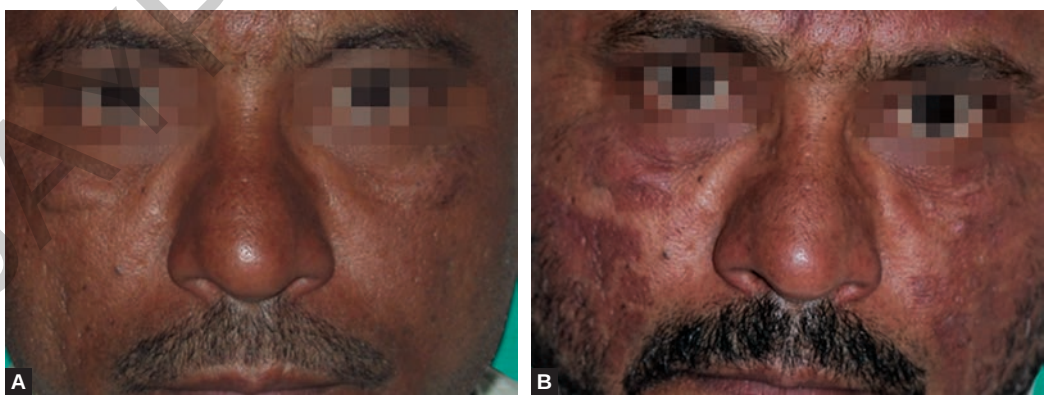


Figure 7: Postinflammatory hyperpigmentation in tanned patient.

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Box 4: How to prevent or minimize postinflammatory hyperpigmentation?

- Golden triad of safety in fractional lasers
- Postoperative moist milieu with proper dressing
- A stat dose of prednisolone 20–40 mg, one tablet immediately and one after 12 h. Addition of triamcinolone in tumescent solution works in similar way
- Strict sun protection and start sunscreen from the 2nd day to be applied three hourly
- Bleaching regimen with 4% hydroquinone and mometasone from 2 days after scabs are fallen to be applied for 1 week daily in night then alternate daily for 2 weeks
- Avoid repeat treatment earlier than 6 weeks

full face or a larger area is treated. Topical antibiotics are discouraged as it may lead to sensitization and developing contact allergy to the antibiotic molecule. Washing hands with soap and water before touching the wound after treatment is recommended for both treating physician as well as patient.

Reactivation of Herpes Simplex Labialis

Treatment with fractional CO_2 laser on face may lead to reactivation of herpes simplex virus type 1 in susceptible individuals (Figure 10). Overall incidence is much less.

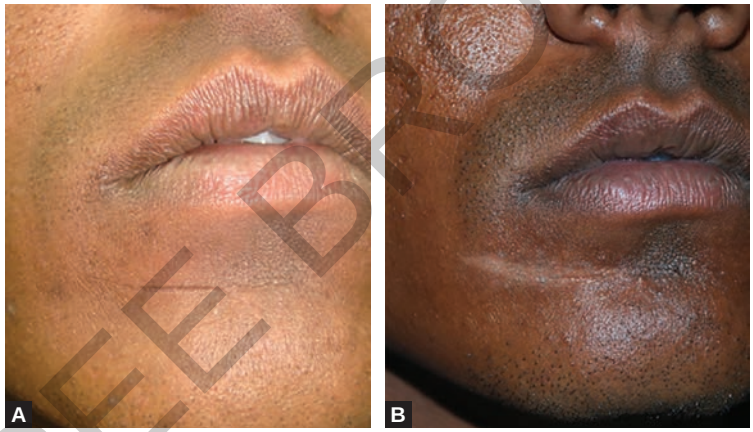


Figure 8: Postinflammatory hypopigmentation is common in tanned patients and in seborrheic areas.



Figure 9: Erythema is common after fractional carbon dioxide laser. It is short-term in UltraPulse and long term in wider pulsed lasers.

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This may lead to prolonged healing and undesired worsening of scars. A prophylaxis with 500 mg valacyclovir twice a day starting from a day prior to procedure continued till 3 days after is recommended in all the cases. At slightest suspicion of herpes infection, one should escalate the dose to full therapeutic dose, i.e., 1 g thrice a day.

Reactivation of Psoriasis

A case of burn scar was treated with fractional ablative laser and patient developed abnormal scaling in treated area (Figure 11). It was diagnosed initially as infection and later as contact allergy and treated without improvement until similar lesions appeared on other areas of body. Within a week, patient evolved into generalized plaque psoriasis. It was a rare incidence of first attack of psoriasis triggered by fractional laser. Later prednisolone and methotrexate in appropriate dosages cleared the lesions completely.



Figure 10: Reactivation of herpes simplex virus type I, though commonly mentioned in literature, is less common in practice.

Reactivation of Lichen Planus

Figure 12 shows a case of inactive, healed generalized lichen planus with postinflammatory pigmentation and scarring. Superficial wide fractional CO_2 laser (Active FX) was planned and performed at fluence of 125 mJ. This dose chosen in initial learning curve was clearly very aggressive and precipitated reactivation of lichen planus by Koebner's phenomenon. It was promptly treated with systemic and topical medical treatment.

Reactivation of Vitiligo

Resurfacing a patch of vitiligo is a common practice. However, an occasional patient may

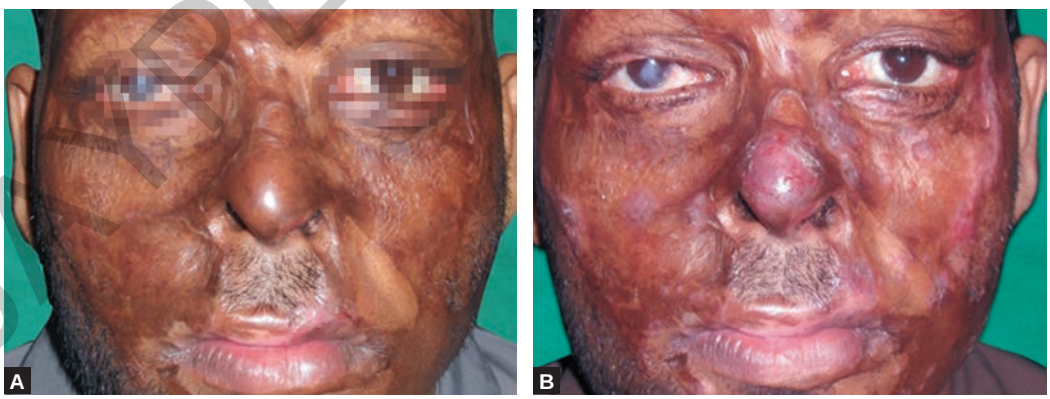


Figure 11: Precipitation of psoriasis after fractional ablative laser. In fact, this was first attack in this patient that took long to confirm the diagnosis till similar patches elsewhere appeared. Standard anti-psoriatic therapy resolved the lesions.

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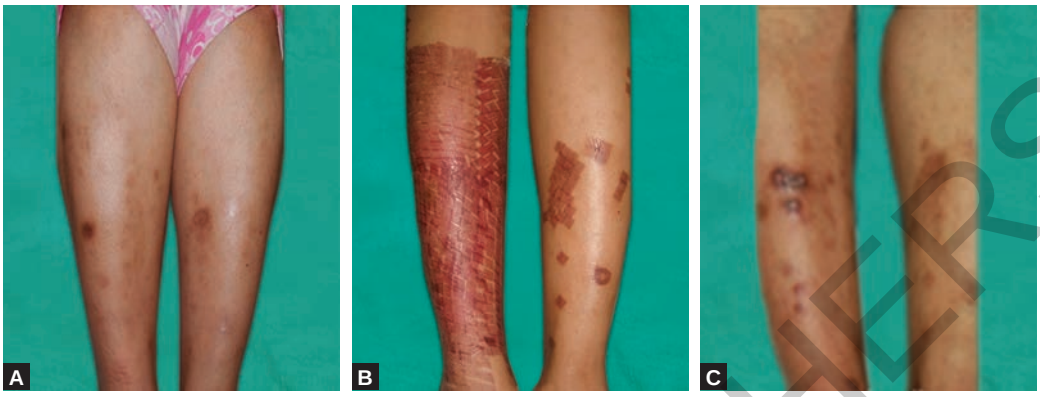


Figure 12: Reactivation of lichen planus after fractional laser. This case of quiescent lichen planus was treated for residual scars and pigment with fractional lasers, aggressive parameters resulted in Koebner phenomenon.

have Koebner's phenomenon and reactivate previously stable vitiligo. Figure 13 shows a case treated with fractional laser for acne scar precipitated into active vitiligo. This patient responded to topical tacrolimus, oral minipulse of steroids and twelve sessions of 308 nm excimer laser.

Contact Allergy

Contact allergic dermatitis due to topical antibiotic molecule or its sensitization leading to future contact allergy is common after fractional lasers. Fractional CO_2 laser creates channels into epidermis that remain patent for more than 48 hours. Entry of antibiotic molecule or its base into epidermis induce allergic response in previously sensitized individuals or induce sensitization making that individual prone for contact allergy in the future. Framycetin, mupirocin, and fusidic acid are common sensitizers. Avoiding topical antibiotics, giving oral antibiotic cover, using inert dressing medium like white petroleum jelly or other fragrance free moisture base, and using dilute white vinegar to maintain skin pH acidic will help preventing antibiotic sensitization.

Worsening of Scar

Very aggressive parameters of fractional CO_2 laser will eliminate all the advantages of fractional energy delivery and will render treatment as risky as traditional ablative CO_2 laser treatment, leading to scarring and hypertrophy. Restricting to golden triad of safety in parameters and safe patient selection parameters will help prevent this complication.

Damage to Deeper Structures

Initially, CO_2 laser, fractional, or traditional had limited penetration. With advent of narrow deep fractional mode (SCAAR FX) that has the capability to reach up to 4 mm, they had the potential to cause damage to deeper vital structure. There is a report of SCAAR FX causing panniculitis and draining necrosed fat over days through fractional channel. Traditionally, fractional lasers in patients previously injected

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Figure 13: Reactivation of vitiligo after carbon dioxide laser in previously stable vitiligo case. Her depigmented patches responded to twelve sessions of excimer laser.

dermal fillers were considered safe.[7] Care should be taken while using newer deep narrow fractional CO_2. Therefore, adjusting parameters considering thickness of skin and underlying structures is the key for safety. Use of tumescent anesthesia in case of facial scars or burn scar has advantage of separating deeper vital structure away from skin.

Formation of New Keloid

It is rare but a possible complication. Low power device, aggressive parameters, unfavorable patient factors, and neck area of treatment are risk factors for developing keloid (Figures 14 and 15).

❑ CONCLUSION

Fractional way of energy delivery has made ablative CO_2 and Er:YAG lasers far safer and less ablative. Benefits of fractional lasers remain in fractional column of injury that is surrounded by normal tissue. Aggressiveness in any parameter will convert this into bulk heat injury leading to complications. High wattage machine, UltraPulse structure of pulse, and less density are key determinants of safety in fractional lasers.

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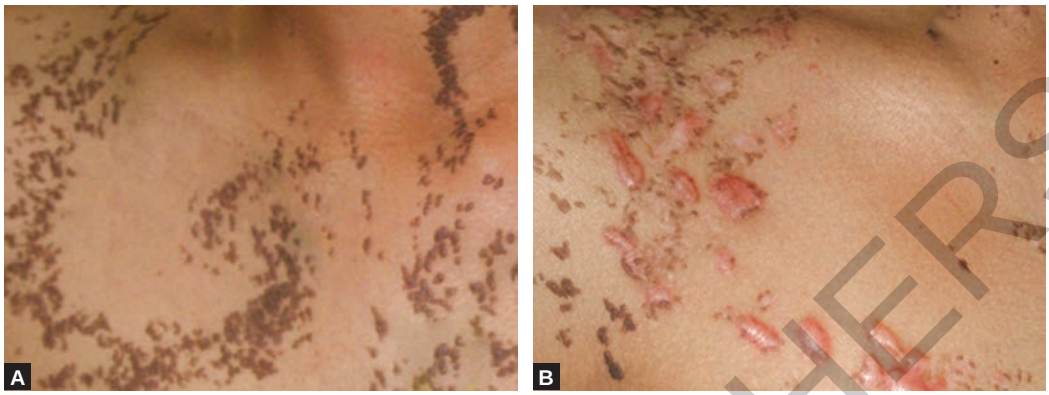


Figure 14: Formation of keloidal scar: low power carbon dioxide devices with more coagulation, failure to remove charred tissue in between passes, and inappropriate operative techniques are commonly implicated.



Figure 15: Erbium doped: yttrium-aluminum-garnet laser, UltraPulse carbon dioxide laser, removal of charred tissue in between passes yield safe results in similar case.

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