Fractional Resurfacing: Separating Fact From Fiction

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Ablative fractional resurfacing has emerged as a popular treatment modality for facial photodamage and acne scarring based on its efficacy and safety. However, it is difficult to assess the accuracy of these various claims because of its rapid adaptation. The author has attempted to clarify the claims made regarding lasers based on his clinical experience in the development of this procedure.

Photoaging of the skin results in epidermal atrophy, dyschromia, cellular atypia, and loss of dermal integrity. It is characterized by loss of collagen, fragmentation of elastic fibers (solar elastosis), and capillary ectasia.[1,2] Rejuvenation of sun-damaged skin has been accomplished by destroying or removing these outermost layers of tissue with chemical peels, dermabrasion, or laser ablation. The healing process replaces the treated tissue layer with new, healthy tissue. The gold standard for rejuvenation of photodamaged skin has been the pulsed CO_2 laser.[3-7] Acne scars, as well as surgical and traumatic scars, have been treated with this same technique with excellent results.[8,9] Though these laser resurfacing procedures are capable of producing dramatic improvement, the procedures have fallen out of general use because of the long healing time, inherent procedural risks for pigment changes and scarring, and the significant operator skills necessary to achieve optimum results.[10-14]

In response to the problematic nature of ablative resurfacing, a number of noninvasive, nonablative lasers have been developed. These lasers spare the epidermis, usually by a cooling technique, and heat the dermis to produce a subclinical wound, resulting in a wound-healing response and generating new collagen.[15,16] These lasers offer minimal risk and minimal downtime, but frequently deliver minimal results as well.[17-20]

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The concept of fractional photothermolysis was developed to address the shortcomings of both the ablative and nonablative treatment modalities. Fractional photothermolysis is characterized by the creation of microscopic zones of thermal damage with spatial separation between columns of damaged tissue arranged in a pixel-like array across the skin's surface.[21,22] The initial devices were nonablative, using a mid-infrared laser source.[23] The success of these lasers has led to the development of ablative fractional resurfacing, using either the CO_2 laser (10,500 nm) or the erbium laser (2940 nm).[24-27] An important aspect of this fractional approach has been the microscopic studies showing a generalization of the wound-healing response throughout the dermis following treatment with a fractional CO_2 device.[28]

The Fraxel re:pair was the initial fractional CO_2 laser to reach the market. Today, there are at least 10 companies who manufacture a fractional CO_2 laser and at least 4 companies who manufacture a fractional erbium:YAG laser (Table).[29]

While there are definite differences among these lasers, it is beyond the scope of this paper to examine each laser. The author's experience has primarily been with the use of the Fraxel re:pair, and its characteristics in his hands will be used as a model of realistic clinical expectations.

The market for these lasers has developed rapidly and there are many claims being made by various physicians and company spokespersons that are difficult for the interested physician to evaluate. The purpose of this paper is to attempt to answer whether various claims being made are true or false.

FALSE CLAIMS

Ablative Fractional Resurfacing Myth

There is the belief that ablative fractional resurfacing can be performed in an office setting using only topical

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anesthesia and oral sedatives. The truth is that ablative resurfacing is very painful. Peak tissue temperatures reach 300°C or higher, and depths greater than 1500 µm can be achieved. In the author's experience, this cannot be performed using only topical anesthesia. In his office, 10% to 20% of patients request general anesthesia. However, the majority of patients are treated with the use of oral and intramuscular sedatives and pain medications, such as topical lidocaine 7%, tetracaine 7%, infraorbital nerve blocks, supraorbital nerve blocks, mental nerve blocks, or local subcutaneous infiltration of xylocaine 0.25% and epinephrine. Ablative fractional resurfacing using only topical anesthesia can be accomplished with superficial (300 µm or less) and low density (5%–10%) parameters.

Minimal Downtime Myth

There is the belief that there are only 3 to 5 days of downtime associated with ablative fractional resurfacing. The fact is that even though this procedure results in wounds healing quickly, it is unrealistic for the patient to expect to be mostly healed in 3 to 5 days. As with all procedures, downtime and efficacy are directly correlated and both are related to intensity of treatment. The intensity is a function of pulse energy as well as density. However, in the author's experience, density is the primary determinate of healing time. For the wound to heal in 3 to 5 days, it requires a density of only 10% and usually a pulse energy of 25 mJ or less. With these parameters, patients do heal in 3 to 5 days, but there is a much broader spectrum of clinical response than when high treatment densities are used. Treatment densities of 30% to 50% generally require 7 to 10 days of healing before makeup can be worn (Figure 1). When treating at these higher densities, a much more predictable clinical response can be achieved. Treatment off the face results in wounds healing slower and usually requires 10 to 14 days for the epidermis to fully peel.

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Figure 1. A female patient preprocedure (A), one day postprocedure (B), and 6 days postprocedure (C), using a 40-mJ pulse and 40% density. Capillary bleeding is commonly seen postprocedure, but resolves within 24 hours. Epidermal peeling usually requires 5 to 7 days, but can persist in some patients as long as 10 days.

Risk for Scarring Myth

Some patients think there are no risks for scarring as a consequence of fractional CO_2 resurfacing. In fact, scarring of the neck has been reported.[30] The lower neck is particularly problematic and risky for aggressive treatment. Generally, scarring has been preceded by wound infection. Densities greater than 20% on the lower neck appear to be at higher risk for problematic healing. There is a point where the density of treatment becomes too high for the natural wound-healing cascades to proceed efficiently. This is likely to be true for all anatomical locations, but will vary tremendously according to the biological dynamics of each particular area. Close surveillance is strongly recommended for all patients treated with densities considered to be relatively high for the anatomical area. Early intervention with wound culture and supportive measures is critical.

TRUE CLAIMS

Fractional CO_2 Resurfacing Is Comparative to Pulsed CO_2 Resurfacing

Fractional CO_2 resurfacing is as effective as pulsed CO_2 resurfacing. Fractional CO_2 resurfacing using high pulse energy and high density heats a larger volume of tissue very deeply, as well as vaporizing a thin column of tissue in the center of each heated column. The net effect of these factors is significant tissue tightening, rejuvenation of photodamaged skin, and improvement in scar appearance. This is particularly true of the eyelids, cheeks, and forehead (Figure 2).

The cheeks have always been a problematic area for pulsed CO_2 laser resurfacing. However, with fractional CO_2 resurfacing, this is an area of excellence. Hypopigmentation, a common problem with pulsed CO_2 resurfacing in this area, has not been reported with fractional CO_2 resurfacing. Relative hypopigmentation of the cheeks, compared to the darker pigment of untreated neck skin, has commonly resulted in a line of demarcation at the jawline. The fact that the neck can be treated with fractional CO_2 resurfacing at the same time as the face eliminates the occurrence of the demarcation line at the jaw and neck.

Lip lines, particularly those at the vermilion border, are the only facial lines that do not respond as effectively with a single treatment of fractional CO_2 resurfacing as compared with pulsed CO_2 resurfacing. With repeated treatment sessions, these lines will probably respond. However, it is the author's preference to use pulsed CO_2 and erbium resurfacing to sculpt away these lines in a single treatment session (Figure 3). This is easily combined with full-face and neck fractional CO_2 resurfacing.

No Prolonged Erythema

There are no problems with prolonged erythema using fractional CO_2 resurfacing. Erythema is a necessary component of wound healing and neocollagenesis. The duration of erythema is directly related to the intensity of treatment. Prolonged erythema (6 months or longer) is usually related to wound-healing problems and often leads to hypopigmentation or scarring.

With high-volume fractional CO_2 resurfacing of the face, there is intense redness for approximately one week.

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Figure 2. A female patient with significant photodamage of the face and neck prior to treatment (A) and 2 weeks posttreatment with a 40-mJ to 50-mJ pulse and 40% to 50% density (B). Tightening of eyelids and cheeks are evident, as well as softening of facial lines and improvement in neck texture.

Figure 3. A female patient with perioral wrinkling and skin damage prior to treatment (A) and 3 months posttreatment with a pulsed CO_2 laser and erbium:YAG laser (B).

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Figure 4. A male patient with acne scars prior to treatment (A) and one month posttreatment with a 40-mJ pulse and 25% density (B).

This fades approximately 50% during the second week. Generally, the residual erythema fades gradually during the next 4 to 6 weeks.

When treating off the face and neck, particularly on the legs, erythema with fractional CO_2 resurfacing takes much longer to resolve than the erythema of facial treatments. This merely reflects the slower wound-healing response of these anatomical locations.

Fractional CO_2 Resurfacing Is the Best Treatment for Tightening Skin

While fractional CO_2 resurfacing can result in dramatic tightening of facial skin, it is a secondary benefit. Rejuvenation of photodamaged skin is the primary objective. Significant tightening of the eyelids and cheeks are commonly seen (Figure 2). This is usually a delayed event, occurring over a 3- to 6-month period, and secondary to wound-healing dynamics. Tightening the skin of the neck is difficult to achieve with any predictability. However, improvement in texture of the photodamaged skin of the neck always occurs. Tightening of the arm and leg skin does occur, but again the primary goal is rejuvenation of the photodamaged skin resulting in improved color, texture, and thickness of atrophic skin.

Fractional CO_2 Resurfacing Is the Best Treatment for Scars

Fractional CO_2 resurfacing is the best treatment for scars of all types, including acne scars, traumatic scars, and surgical scars. Though multiple treatment sessions are often necessary, fractional CO_2 resurfacing results in more significant improvement in scars of all types than any other treatment modality the author has ever used (Figure 4). Other physicians have found this to be true as well.[31-34] The reasons that this may be true are the deep penetration and vaporization of tissue (up to 1700 µm), the secondary tightening that occurs, the significant generation of new collagen, and the safety of using this approach, with the appropriate parameters anywhere on the body. Partial repigmentation of hypopigmented scars has been reported and is a common observation.[32]

FRACTIONAL CO_2 RESURFACING CAN BE USED OFF THE FACE

There are no problems in using fractional CO_2 resurfacing off the face. The thermal columns created by fractional resurfacing are small enough in diameter to heal without requiring neovascularization and are surrounded by untreated skin. Therefore, any single column can heal naturally and without problems, as long as the numbers of those columns do not overwhelm the healing capacity

Figure 5. A patient's arm prior to treatment (A) and 3 months posttreatment with a single treatment using a 25-mJ pulse and 15% density and Q-switched alexandrite laser (B).

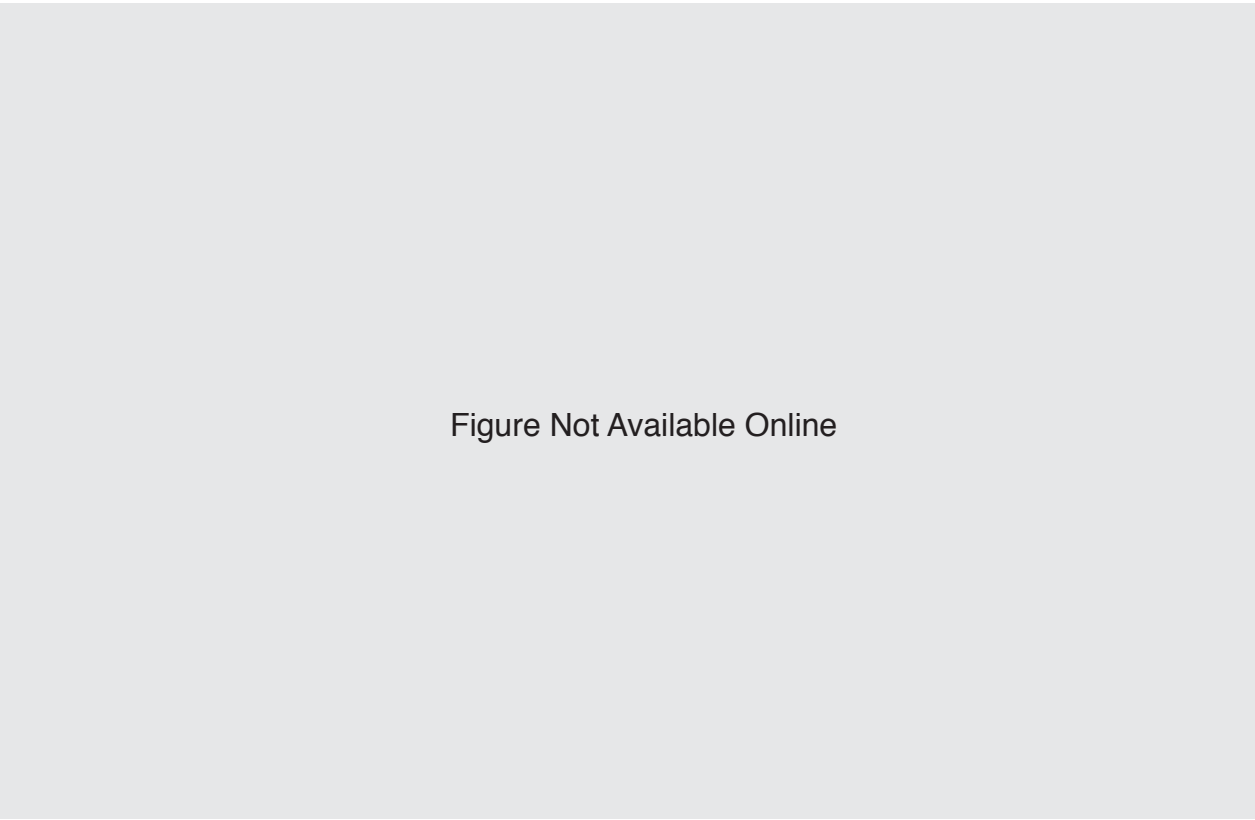

Figure 6. A female patient with melasma prior to treatment (A) and 3 months posttreatment with a 20-mJ pulse and 40% density (B).

of the anatomical location. Close attention is required to achieve the appropriate density for the area of treatment. In the author's experience, densities greater than 20% from the lower third of the neck and below are not recommended. In the author's office, the neck, chest, and face are often treated during the same session. Hands and arms are also commonly treated (Figure 5). Acne scars on the back and stretch marks on the abdomen, hips, and thighs have been treated as well.

CLAIMS THAT MAY BE TRUE

Stretch Marks and Melasma May Respond to Fractional Resurfacing

Stretch marks and melasma may respond to treatment with fractional resurfacing. Both of these conditions have no known treatment for complete eradication of the lesions. However, Fraxel re:store has been reported to deliver improvement in melasma.[35,36] In the author's experience, this has been true only in patients with Fitzpatrick skin types I and II because patients with darker skin tend to develop very persistent postinflammatory hyperpigmentation (PIH) and worsening of melasma.

Fractional CO_2 resurfacing is also very capable of blending the melasma pigmentation with the patient's normal pigment in darker skin and eliminating melasma in some individuals with Fitzpatrick skin types I and II (Figure 6). It has not been determined if treatment can result in long-term improvement. Successful treatment of striae using Fraxel re:store has been reported.[37-39] Based on the improvement seen in these individuals, the author has treated a small number of patients using Fraxel re:pair. Some improvement has been seen in these patients using pulse energies of 20 mJ and densities of 10% to 20%, but erythema of the treated area may persist for 3 months or more on the hips and thighs. It is likely that multiple treatment sessions may be necessary for maximum benefit. Combining sessions of the nonablative Fraxel re:store with the more aggressive Fraxel re:pair may be a good strategy.

Fractional CO_2 Resurfacing May Cause Dyspigmentation

There may be problems with dyspigmentation, either hypopigmentation or PIH, with fractional CO_2 resurfacing.

To the author's knowledge, there have been no cases of hypopigmentation caused by fractional CO_2 resurfacing. With this method, PIH does occur in some cases. In the author's experience, the incidence of this side effect is dramatically less (probably 10%–20% of Fitzpatrick skin types IV and V, vs 80%–90% using pulsed CO_2 resurfacing) and heals much more rapidly with appropriate treatment.[40]

In the author's experience with pulsed CO_2 resurfacing, the average case of PIH resolves in 1 to 2 months.

CONCLUSION

Ablative fractional resurfacing is an innovative method of delivering effective treatment of photodamage on the face and body as well as many types of scarring, particularly acne scarring. Its safety and speed of healing are far greater than any prior ablative technologies or procedures based on the concept of small thermal columns that are surrounded by untreated skin. As long as the percentage of skin coverage does not exceed the healing capacities for the specific anatomical location of the treatment, it is extremely safe; however, ablative fractional resurfacing remains a procedure that requires skill, knowledge, and expertise and cannot be assumed to be risk free. In the author's opinion, this is the most significant advancement in laser technology during the last 20 years.

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