Acne is one of the most frequent inflammatory chronic dermatoses of the pilo-sebaceous unit, requiring a large amount of care and treatment. Acne vulgaris affects approximately 85% of adolescents (1). Although early treatment of acne lesions and inflammation with drugs is beneficial in preventing acne scarring, many patients still present troubling and noticeable scars (2). Facial scarring occurs to some degree in 90% to 95% of patients, with both sexes affected equally (4-6). Acne scarring can lead to significant psychological distress. The degree of psychosocial distress is not correlated with the severity, size, or location of the scarring, but rather the patient subjective perception of their scars (7 -10). Clinicians should consider the psychosocial sequelae of skin disease not only in those with objectively more severe disease, but also in patients across the severity spectrum (10). The severity of post-acne scars is correlated with the duration of inflammatory reactions (11, 12) that is linked to genetic differences in cell-mediated immune responses. A variety of modalities have been used to treat atrophic acne scars including punch excision, dermabrasion, chemical peels, fillers, and traditional ablative and non-ablative lasers, each with varying degrees of success and adverse reactions (13, 14). The most efficient way to minimize acne scars, still remains to prevent them. An appropriate therapy of the active acne prescribed at the right time can reduce inflammation processes and therefore can reduce the severity of scarring. Treatment of active acne in the early stage can minimize the long lasting sequelae.

Post-acne scarring is very difficult to treat. Although traditional treatments can improve the appearance of acne scars, they cannot entirely or permanently repair them (5, 15, 16). The choice of the right treatment (or combination of treatments) depends on objective and subjective elements. Type, subtype, age, color, distensibility of scars, and Fitzpatrick skin type are objective elements while concerns, expectations and compliance are subjective elements. Usually patient expectations are very high (sometimes unrealistic) and almost always higher than the real outcome the physician can provide. This means that matching individual patient needs to the appropriate treatment modalities requires being extremely clear on possible outcome, clear instructions to be provided regarding treatment protocols and possible adverse effects. All these should be the goal of the first consultation. Also, any active acne must be treated before addressing acne scarring (3, 15, 17, 18, 19).

**Morphology and classification**

Different degrees of the different wound healing processes triggered by active acne lead to a huge amount of different clinical frameworks. There are two basic types of scars depending on whether there is a net loss or gain of collagen (atrophic and hypertrophic scars). Eighty to ninety percent of people with acne scars have scars associated with a loss of collagen (atrophic scars) compared to a minority who show hypertrophic scars and keloids (5).
Hypertrophic scars and keloids
Hypertrophic scars and keloids are associated with an excessive collagen deposition and decreased collagenase activity. Hypertrophic scars are typically pink, raised, and firm, with thick hyalinized collagen bundles that remain within the borders of the original site of injury. The histology of hypertrophic scars is similar to that of other dermal scars. In contrast, keloids form as reddish-purple papules and nodules that proliferate beyond the borders of the original wound; histologically, they are characterized by thick bundles of hyalinized acellular collagen arranged in whorls. Hypertrophic scars and keloids are more common in darker-skinned individuals and occur predominantly on the trunk (5).

Atrophic scars
Atrophic acne scars are much more common than keloids and hypertrophic scars with a ratio of 3 to 1. They have been sub-classified into ice pick, boxcar (shallow and deep), and rolling scars (Table 1). With atrophic scars, the ice pick type represents 60%–70% of total scars, the boxcar 20%–30%, and rolling scars 15%–25% (14).

Table 1 – Classification of acne scars as their morphology adapted from (14)

<table>
<thead>
<tr>
<th>Acne Scars Subtype</th>
<th>Clinical Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ice pick Ice</td>
<td>Pick scars are narrow (&lt;2 mm), deep, sharply margined epithelial tracts that extend vertically to the deep dermis or subcutaneous tissue.</td>
</tr>
<tr>
<td>Boxcar</td>
<td>Boxcar scars are round and oval depressions with sharply demarcated vertical edges, similar to varicella scars. They are clinically wider at the surface than ice pick scars and do not taper to a point at the base. They may be shallow (0.1–0.5 mm) or deep (≥0.5 mm) and are most often 1.5 to 4.0 mm in diameter.</td>
</tr>
<tr>
<td>Rolling</td>
<td>Rolling scars occur from dermal tethering of otherwise relatively normal-appearing skin and are usually wider than 4 to 5 mm. Abnormal fibrous anchoring of the dermis to the subcutis leads to superficial shadowing and a rolling or undulating appearance to the overlying skin.</td>
</tr>
</tbody>
</table>

In the past, several classifications and scales have been proposed. Goodman and Baron proposed a qualitative scale and then presented a quantitative one (20, 21). The qualitative scarring grading system proposed by Goodman and Baron (21) is simple and universally applicable (Table 2). According to this classification, four different grades (based on the visibility of the scars at the social distance of 50 cm) can be used to identify different clinical frameworks (Table 2).
Table 2 – Goodman and Baron qualitative scar grading

<table>
<thead>
<tr>
<th>Grades of Post Acne Scarring</th>
<th>Level of disease</th>
<th>Clinical Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Macular</td>
<td>These scars can be erythematous, hyper- or hypopigmented flat marks. They do not represent a problem of contour like other scar grades but of color</td>
</tr>
<tr>
<td>2</td>
<td>Mild</td>
<td>Mild atrophy or hypertrophy scars that may not be obvious at social distances of 50cm or greater and may be covered adequately by makeup or the normal shadow of shaved beard hair in men or normal body hair if extra facial</td>
</tr>
<tr>
<td>3</td>
<td>Moderate</td>
<td>Moderate atrophic or hypertrophic scarring that is obvious at social distances of 50cm or greater and is not covered easily by makeup or the normal shadow of shaved beard hair in men or body hair if extra facial, but is still able to be flattened by manual stretching of the skin (if atrophic)</td>
</tr>
<tr>
<td>4</td>
<td>Severe</td>
<td>Severe atrophic or hypertrophic scarring that is evident at social distances greater than 50cm and is not covered easily by makeup or the normal shadow of shaved beard hair in men or body hair if extra facial and is not able to be flattened by manual stretching of the skin</td>
</tr>
</tbody>
</table>

Treatments

Although it is understood and agreed that prevention is the main step in avoiding the appearance of post-acne scars, the number of patient with acne scars is still very high. In this section, focus will be brought on the treatment approach for atrophic acne scars.

A variety of modalities have been proposed to treat atrophic acne scars including: punch excision, punch elevation, punch autografting, subcision, dermabrasion, chemical peels, TCA CROSS technique, fillers and fat transplantation, radiofrequency, microneedling radiofrequency, traditional ablative and non-ablative lasers, fractional ablative and non-ablative lasers. Each has varying degrees of success and adverse reactions (13, 14). The aim of this paper is to describe my use of fractional lasers on acne scars but it should not be forgotten that all methods – per se or combined - can be effective. Each case is particular and a proper diagnosis will allow to find the adequate solution. TCA CROSS technique (22) is, for example, in my opinion, the best choice for isolated ice pick lesions; multiple surgeries including punch excision and subcision (23-25) should be always taken in consideration for severe deep scars and eventually surgery should be performed before any other methods. IPL (with vascular filter) or vascular laser like PDL (26, 27) should be considered when the main goal is to treat post-acne red-marks and erythema.

Full beam ablative skin resurfacing with CO2 and Er:YAG lasers was previously considered the gold standard for laser treatment of atrophic acne scars (28-32). However, while extremely effective in re-contouring the skin and improving the appearance of scar texture, treatments are limited by significant downtime, prolonged erythema and potential unwanted adverse effects such as post-inflammatory hyperpigmentation, hypopigmentation, and scarring (33-35).
Most currently available treatment options have trade-offs: often the more effective the option, the greater the risk of adverse events (26). Moreover, a patient need for treatment often has a strong emotional component and is highly subjective. Evaluation of therapeutic benefits from the patient perspective is important in medical decision-making (36). Thus, the plan for treating post-acne scarring should be a shared decision, incorporating both patients’ subjective perceptions and objective clinical practices (37). Best outcomes can be obtained usually combining different techniques and procedures and with multiple sessions of treatment. Best outcomes (in my opinion) can be obtained only by customizing the treatment for each patient, taking into consideration the scars’ appearance and features and the patient needs, expectations and compliance.

Excluding the non-laser modalities briefly described above (and therefore excluding ice pick lesions) the 2 most important and recent procedures to improve acne scars are the ablative fractional resurfacing (AFR) and the non-ablative fractional resurfacing (NAFR). The more severe the case is (considering mostly the scar depth), the more aggressive the treatment will be and I will choose AFR procedures (usually more than 1 procedure and up 3 sessions, spaced by at least 6 months. Other approaches and treatment settings may allow shorter intervals and this is upon the discretion of the treating Physician). I would choose NAFR for less severe cases, for patients who are not willing to accept the downtime of AFR and understand they will get a lower outcome to AFR.

**AFR – Using AcuPulse™**

Ablative fractional resurfacing creates microscopic treatment zones (MTZ) to stimulate a wound healing response. With this technique, the tissue surrounding each column is spared, ultimately resulting in rapid epidermal regeneration with reduced downtime and adverse reactions compared to treatment with traditional full ablative techniques.

AcuPulse AcuScan120™ scanner is capable of generating 0.12 mm microbeams, as well as 1.3 mm spots, in fractional patterns:

- The smaller diameter microbeams are used when deep skin penetration is required.
- While the larger spots affect the skin more superficially.
- A combination mode delivers the 0.12 mm and 1.3 mm beams sequentially in the same area, such that deeper and more superficial pathologies can be treated in the same pass.

**Procedures**

1. Pre-treatment – with the patient in a sitting position, all scars are marked with a surgical pen and then a potent topical anesthetic is applied for a duration as per manufacturer’s guidelines (typically one hour). Just before treatment, anesthetic should be removed, skin should be cleansed and dried.

2. Treatment
   a. A **first pass** is performed at the base of each scar using the **deep mode**, the smallest square pattern, relatively high energy (20-30 mJ) and very low density (3-5%). The aim of this pass is to **stimulate collagen production at the base of the scar to obtain its elevation**.
   b. A **second pass**, using the **combo mode**, is usually performed immediately after. Using the largest hexagon pattern the deep mode has 12.5-17.5 mJ of energy and a density of 10%-15% while the superficial mode has 90-120 mJ of energy and a density of 60%. The aim of this second pass is to **obtain a tightening effect, collagen remodeling and an improvement of skin color**.
c. The procedure is concluded with a **third superficial pass**, (energy 70-90 mJ and density of 40%), to cover the remaining facial areas free of scars, **avoiding any difference in color between the treated and non-treated areas**.

3. Post treatment – I prescribe antibiotics, antiviral and antifungal drugs to all my patients. Patients are instructed to apply an ointment several times a day for 4-5 days following the procedure, avoid direct sun exposure and apply SPF 50+ for the following 2-3 months. Dark skin patients are at higher risk of hyperpigmentation that can be eventually treated using a daily application of the Kligman-Willis (38) modified formula for 2 months (tretinoin 0.025%, Vitamin C 3%, Hydroquinone 4% and flucinolone acetonide 0.1%). Erythema and edema can last for 7-21 days in the event of prolonged erythema fluorinated steroids creams can be used for a few days.

The golden rule stating that “if you increase the energy you have to simultaneously decrease the density” always applies:

- In dark skin patients, the energy should be 30% ower than that for light skin (as described above) and the density is never to go beyond 10%.
- It is recommended to restrict the second pass to a Deep mode only (and not a COMBO) on very dark skin types.

Figure 1 is a schematic explanation of the 3-step procedure with the AcuPulse.

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Figure 1: Steps of fractional ablative resurfacing for acne scars. The second pass (2a and 2b in the figure) is performed using a combined fractional modality. The superficial ablation (2b) automatically follows the deep ablation (2a)
NAFR – Using ResurFX™

Based on the well-established concept of fractional injury to the skin which enables a rapid healing, the non-ablative fractional lasers are vastly used to treat acne scars. The coagulation columns created by the procedure will be replaced by new tissue, and the secondary effect is the dermal remodeling beyond the coagulation zones. NAFR devices are considered less effective than AFR (39) for the treatment of acne scars. NAFR devices do play a role on less severe cases and for patients who are not willing to accept the downtime and the risk related to AFR. The ResurFX is a 1565 nm non-ablative fractional device delivering microbeams of some 0.11 mm of diameter with an energy up to 70 mJ. Three main features distinguish this device from other NAFR: Shape and dimension of the scan can be modified, number of microbeams per cm² can be increased from 50 up to 500, and the microbeams are delivered in a non-sequential scan-controlled modality, in addition to continuous contact cooling.

Disclaimer: in the US, treatment of Acne Scars by ResurFX is not cleared by FDA.
Procedure

1. Pre-treatment – same as with the AFR procedure, all scars must be marked and treatment area anesthetized.

2. Treatment

   a. A **first pass** is performed using the smallest circular pattern, only on the base of each scar using 300-350 microbeams/cm² and energy of 20-30 mJ. The aim of this first pass is to **stimulate collagen production at the base of the scar to obtain its elevation**.

   b. A **second pass** is done with the doughnut pattern (adjusting the size according to the diameter of each scar), using a lower number of microbeams/cm² (150) and a higher energy (40-50 mJ) over each scar. The aim of this second pass is to **obtain a collagen remodeling of the tissue surrounding the scar**.

   c. A final and **third pass** is performed over the entire affected area using the largest circular or hexagonal pattern, 30-35 mJ of energy and 200-250 microbeams/cm². Non-affected areas (such as forehead) will now treated with very low settings of energy and density to **avoid visual difference between treated and non-treated areas**.

3. Post treatment – NAFR treatment does not require specific post-op care. Patients are requested to apply a moisturizer several times a day till the microcrusting flakes off. Direct sun exposure is to be avoided, and SPF 50+ needs to be applied till the next procedure.

Dark skin patients should be treated using lower energy and density of microbeams (about 30 to 40% less than for fair skin) to reduce the risk of PIH. A complete treatment is composed by at least 4 procedures performed 4-6 weeks apart.

Figure 3 is a schematic explanation of the 3-step procedure with the ResurFX.
Figure 4: Patient with acne scars Goodman 3B submitted to 4 sessions of ResurFX, 4 weeks apart. 6 months follow-up. Please note that the pigmentation was treated with a combination of IPL and ResurFX, called Photofractional™, at high density and low energy.

**Summary**

Treatment of acne scars still remains a challenge. The perfect treatment does not exist and many procedures have been proposed. The best way not to have acne scars is to prevent their occurrence and therefore an appropriate therapy at the right moment on active acne should be mandatory. Unfortunately, often active acne is undervalued or even rejected by physicians, parents and sometimes by patients themselves, therefore the number of patients with acne scars is still very high. Many grading scales have been proposed to classify acne scars and there isn’t a globally accepted way to classify them or quantify their improvement after procedures. Frequently the right treatment of acne scars is a combined customized procedure including surgery, peeling, injectables lasers and other energy-based devices. All procedural plans have to be shared with the patient taking into account not only the clinical appearance and history but also the patient concerns, expectations and compliance.
The patient has to understand that acne scars can only be improved and not completely eradicated. Physicians must be extremely cautious in foreseeing and promising the percentage of improvement after the proposed procedure and it is better to declare a percentage lower than that really possible (this is the simplest way to lower expectations). Physicians must be extremely clear as to the procedure, the number of required sessions and the possible adverse events. Physicians have to discourage a patient if they realize that the subject has unreasonable expectations or has no or minimal compliance. Within the myriads of proposed treatments, AFR with AcuPulse and NAFR with ResurFX, play today a real important role. They are effective and they allow the patient to come back to social life quickly and present a very high safety profile.

References


