

Combining Techniques for Treating Acne Scars

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Abstract The treatment of acne scars is challenging due to the variety in morphology of acne scars and the limitations of the available treatment modalities in their ability to improve scars. Multiple treatment options exist, and each has a unique place in the armamentarium of the acne scar surgeon. In order to optimally treat a patient's scars, a tailored treatment plan must be created in which the patient's specific types of scars are treated with the procedures that are most likely to improve those types of scars. The definition of and the rationale for combination therapy is discussed in detail. The indications for specific procedures are reviewed, highlighting ways that procedures can be combined to most optimally treat patients with certain combinations of scars.

Keywords Acne scar · Scar therapy · Atrophic scars · Fractional laser · CO2 laser · Subcision · CROSS · Scar revision · Punch · Trichloroacetic acid

Introduction

Acne vulgaris is common in the adolescent population [1, 2] and has the unfortunate complication of leading to permanent scarring in a significant percentage of patients. The incidence of acne scarring is not well defined, but it may occur to some

degree in as high as 95 % of those patients who have had acne [3]. The rate of acne scarring in the general population is reported to be between 1 % and 11 % [4, 5].

Having acne scars can be emotionally and psychologically distressing. In addition to having to suffer acne, the actual presence of acne scars is a risk factor for suicide [6] and is linked to low self-esteem, anxiety, depression, body image disorders, anger, altered social interactions, decreased academic performance, and unemployment [7–9]. Although acne vulgaris usually improves with age, the acne scars usually persist. The appearance of acne scars may also worsen with the normal aging process or with photodamage [9].

The pathogenesis of atrophic acne scarring is not completely understood, but is most likely related to inflammatory mediators and enzymatic degradation of collagen fibers and subcutaneous fat [10]. Although the scarring process can occur at any stage of acne, early intervention in inflammatory and nodulocystic acne is the most effective way of preventing permanent post-acne scarring [10].

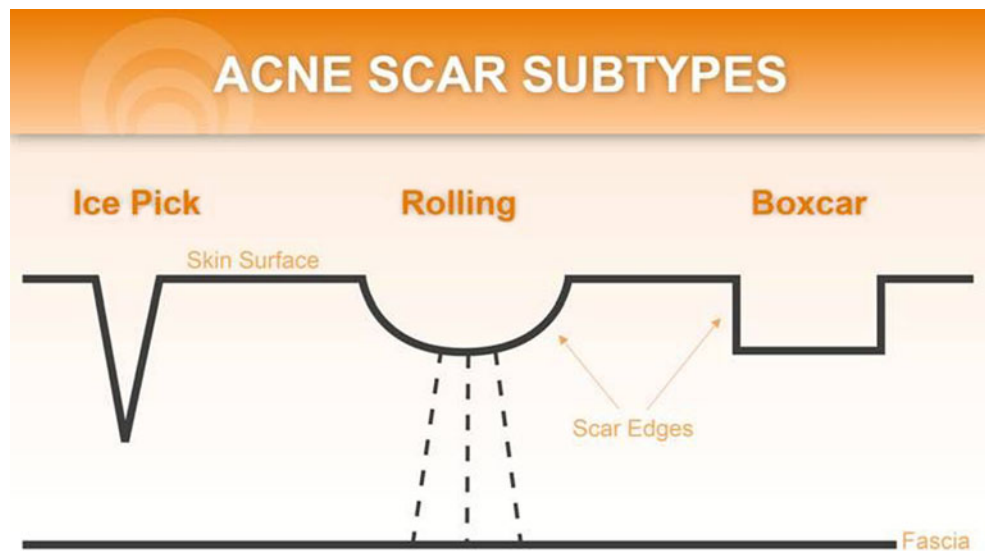
Acne scars can be classified into three different types: atrophic, hypertrophic, or keloidal. Atrophic acne scars are by far the most common type and will be primarily addressed in this article. Multiple grading systems have been introduced to characterize and classify acne scars. The most basic and practical system divides atrophic acne scars into three main types: ice pick, rolling, and boxcar scars (Fig. 1) [11]. It is common for patients to have a combination of two or more types of scars.

A variety of effective treatments for atrophic acne scars have been developed, including excisional procedures, punch elevation, dermabrasion, chemical peels of varying concentrations and application techniques, subcision, and laser procedures including non-ablative, ablative, and fractional. Each of these procedures has a role in treating acne scars, with some modalities being better suited for a certain

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Fig. 1 Acne scar subtypes categorized by morphology [11]



scar subtypes than others. For example, a punch excision or punch graft is an effective treatment option for a deep ice pick scar but would not be as effective for a superficial rolling acne scar. On the other hand, subcision is effective for depressed rolling scars but is less effective for ice pick or boxcar scars [12•, 13]. Furthermore, fractional lasers are effective in treating superficial textural irregularity and color variation but have limited ability to improve scars that are deep [14•]. If multiple procedures were combined, then both deep scars of varying types and fine textural irregularities would likely be improved to a degree that could not be obtained by each procedure alone. The varying morphology of acne scars, especially when multiple types of scars are found in the same patient, suggest the need for combination therapy to provide the most effective treatment.

Combination therapy can be defined in multiple ways. Combination therapy can mean utilizing two or more distinct procedures to treat the skin of one patient. Each separate procedure could be performed either on the same day or on different days. Combination therapy could also mean performing the same procedure multiple times over an extended period of time. A common misconception of patients is that a one-time treatment session will be effective in permanently treating all of their acne scars. However, it is rare that one procedure performed only once will significantly improve mild to moderate acne scarring in a patient. An additional definition of combination therapy could be adding an adjunctive therapy to improve the efficacy of a certain treatment (eg, performing suction after subcision or applying autologous platelet-rich plasma after fractional ablative laser resurfacing).

Combination therapy for acne scars provides multiple advantages. First, appropriately combining procedures that are tailored to the patient's specific combination of scars can lead to improved outcomes. Second, combining treatments

may also lead to a lower number of treatment sessions, decreased cost, and increased patient comfort. The following sections will address the most common procedures used to treat acne scars, highlighting what other modalities could be used in combination for enhanced results. A step-by-step description of each procedure is beyond the scope of this article, but we will discuss the nuances of each procedure that specifically relate to the timing and performance of accompanying procedures.

Ablative Fractional Laser Therapy

Fractional ablative laser therapy utilizing CO₂, Er:YAG, or YSGG laser devices has become a mainstay of acne scar therapy, largely replacing fully ablative lasers due to the shorter downtime and more favorable side effect profile of the fractional devices. Multiple studies have validated the efficacy of ablative fractional resurfacing (AFR) for improving acne scars [15, 16•, 17•, 18]. Ablative fractional lasers improve all types of acne scars but are most effective in treating superficial textural irregularity as well as pigment variation [14•]. AFR is only somewhat effective in improving deeply atrophic scars, whereas certain other procedures are usually more effective in lifting or removing deep scars. AFR can be used in combination with almost any other acne scar procedure to provide an additive effect. In some cases, both AFR and the additional treatment can be performed the same day. For example, AFR can be performed immediately after subcision, high-concentration trichloroacetic acid application, or excisional procedures. It can also be performed at a future date. One advantage of performing procedures on the same day is that the anesthesia used for one procedure can aid in the comfort of the second procedure. Another

advantage is that the periods of downtime associated with each procedure can be combined into one postoperative period, requiring less time away from work or social interactions. The addition of dermal injection or topical application of autologous platelet-rich plasma immediately after AFR is a recently described adjunctive measure that may increase the effect or decrease the side effects [19], but it requires further validation. The specific nuances of combining fractional ablative laser with each of the other procedures for acne scars will be discussed in the following sections.

Non-ablative Fractional Laser Therapy

Similar to AFR, non-ablative fractional resurfacing (NAFR) is a well-established treatment option for acne scars. The treatment indications are also similar to those of AFR in that it is most effective for superficial textural irregularity and color variation but is less effective at improving deeply atrophic scars. Devices currently in use include 1,320 nm neodymium:YAG (Nd:YAG), 1,450 nm diode, 1,540 nm erbium:Glass, and 1550 erbium:Glass lasers [14, 20]. The procedure has the advantages of shorter downtime and less treatment-associated pain as AFR, but requires a greater number of treatment sessions to achieve the effect of AFR (as a rule, 3–4 times as many treatments). NAFR can be combined with almost any other acne scar treatment either on the same day or on different days.

Excisional Procedures

Excisional techniques for treating acne scars include punch excision, fusiform excision, punch grafting, and en bloc or configurate excision of groups of acne scars. Excisional procedures are highly effective for acne scars that are deep or sclerotic or scars that have poor overlying skin quality, such as hypopigmentation or fibrosis [10, 21]. Although excisional procedures are an effective one-time treatment, a major disadvantage is that only the scars that are treated have a chance of improving. It does little for the surrounding textural irregularity or discoloration that frequently is seen in a field of acne scars. Scar excision on the face requires a high degree of surgical skill and careful attention to detail. Acne scar surgeons should also be aware that a subset of acne scar patients will not heal well following excisional procedures, which may be related to a defect in healing [21].

Hwang et al. [22] combined punch excision with fractional laser and long-pulsed Er:YAG resurfacing. Fifteen patients received “total combination therapy”, which consisted of two to three sessions of punch excision followed by fractional and ablative resurfacing on the same day. Five control patients received three sessions of a “sequential combination therapy”

in which punch excision was performed on 1 day and the laser therapy was performed at a future date after the punch excisions were healed. The investigators found that the total combination group showed better effect than those receiving the sequential combination therapy, including greater improvement in acne scars, less suture marks, and mosaic-like scars. An additional reported benefit of performing the procedures on the same day was that the lower number of treatment sessions was more convenient for both patients and physicians [22].

Almost any acne scar procedure can be combined with excisional procedures. High concentration TCA application (chemical reconstruction of skin scars [CROSS] technique) could be performed on the same day for scars that are too small for excision. Subcision combined with excisional procedures is effective and is discussed in more detail in the next section. AFR or NAFR can be performed on the same day as excisional procedures or on different days. If a fractional laser treatment is performed on the same day as an excision, it is recommended the laser procedure be performed *after* the excision and placement of absorbable deep sutures but *before* the placement of the outside epidermal sutures. When excisional procedures and fractional laser therapy are performed on different days, the excisional procedure is usually performed first, as fractional lasers have established efficacy in improving the appearance of surgical scars [23, 24].

Subcision

Subcision is a procedure in which a needle is inserted under the skin and passed in multiple directions in order to create a pocket under the scar and release fibrous attachments, allowing the base of depressed scars to float upward [25]. Subcision is best utilized for rolling acne scars that have normal quality of skin at the base of each scar [12, 13]; it is less effective for treating boxcar and ice pick scars [9, 12]. Subcision can be combined with excisional procedures as is mentioned above, and can also be combined with other procedures that target boxcar or ice pick scars, which are not optimally treated by subcision.

Occasionally certain scars treated with this technique will not improve. One suggested reason for this occurrence is that the roof of the pocket created by subcision immediately re-adheres to the base of the pocket, eliminating the dead space that was created [26]. Creative surgeons have attempted to keep this space open by filling it with exogenous material such as injectable filler materials of various types, artificial dermal material [27], or catgut suture [28], or by filling it with autologous tissue such as fat microdroplets or dermal grafts [29]. Studies and published reports are mixed on the benefit of implanting material subdermally after subcision, as nodules and overcorrected have been reported.

A recently published study by Harandi et al. [26•] attempted to improve the efficacy of subcision by performing suction on the skin surface in the days following subcision for depressed acne scars on the face in order to keep the subdermal pocket from closing. In this case series, 58 patients were treated with subcision and then received repeated suction to the surface of the skin during the 2 weeks following the procedure with a microdermabrasion device. Patients who received daily suction had a significantly greater degree of improvement in their scars compared to those who received late or infrequent suction (72 % compared to 44 %). The authors have utilized this suction technique in patients with acne scars and their clinical experience correlates with the findings of this study in that patients treated with daily suction after subcision have more bruising, swelling, and induration in the weeks after treatment, but they also have greater improvement in their atrophic scars. One downside to performing subcision on the same day as AFR is that the pain and epidermal disruption from the ablative laser precludes the utilization of the suction device in the postoperative period. One of the author's of this review (DF) routinely performs AFR sessions as soon as 1 week after subcision in order to allow the benefit of daily suction while also combining the periods of downtime, as the bruising from subcision often lasts up to 2 weeks.

Subcision can be combined with excisional procedures on the same day in two ways. First, excision and subcision can be performed on different scars. Alternatively, the procedures can be combined by first excising the desired scars, and then performing an exaggerated amount of undermining underneath scars in the surrounding skin (in effect performing a subcision of these scars). The undermined skin is then stretched with the placement of absorbable deep sutures. Grade 2 and 3 scarring includes scars that are removed by stretching the skin [30]. The degree of stretching of the skin (and subsequent improvement in grade 2 and 3 scarring) is proportional to the size of the scars excised.

Soft Tissue Augmentation Fillers

The efficacy of soft tissue fillers is well documented in the treatment of acne scars [31–36]. Fillers for acne scarring can be utilized in two ways. First, agents such as hyaluronic acid can be injected directly under individual scars for immediate improvement. Second, volumizing fillers such as Poly-L lactic acid or calcium hydroxylapatite can be delivered to areas where laxity of skin or deep tissue atrophy is accentuating the appearance of acne scars. Fillers can be combined with fractional non-ablative and ablative laser therapy in a similar way as subcision; however the timing of the procedures and the depth of injection of filler must be kept

in mind. Farkas et al. [37] studied filler and laser interactions in live porcine abdominal skin. A commercially available hyaluronic acid filler was injected intradermally, and then the area was treated 2 weeks later with various lasers. Histology demonstrated that both fractional Er:YAG laser and a fractional CO₂ laser column penetrated deeply enough to interact with hyaluronic acid deposits in the skin. Although there was no clinical extrusion of filler seen in the study, the authors recommended that when “planning superficial filler placement with aggressive deep resurfacing, it may be best to treat with the laser before the soft tissue filler injections and to stage these procedures in order to maximize the treatment effect of each of the modalities” [37].

Focal Application of High Concentration TCA Solution

About 80 % to 100 % trichloroacetic acid (TCA) can be applied focally to acne scars using a sharp-tipped wooden applicator, fine-tipped paint brush, or a needle. It is best suited to treat ice pick or small boxcar acne scars. This technique has been called “dot peeling” [14•] or “CROSS” [38]. In order to achieve maximum efficacy, patients are treated in multiple treatment sessions over a period of time, usually at least 1 month apart. The safety and efficacy of focal TCA has been established in multiple studies, including studies of skin types III–IV [12•, 38, 39]. Focal TCA can be performed on the same day as subcision, excisional procedures, AFR, or NAFR (Fig. 2). It can also be performed on separate days.

A case series of 10 Korean patients with type IV–V skin published by Kang et al. [14•] evaluated a combination treatment of dot peeling (focal application of high concentration TCA), subcision, and NAFR using a 1550 nm



Fig. 2 Combination procedure of subcision followed by focal TCA application followed by fractional ablative laser therapy all on the same day (photo courtesy of Peter Rullan, MD)

fractional laser device. They performed 4 NAFR monthly laser treatments, and twice during the treatment course they performed a sessions of combined dot peeling and subcision, spaced 2 weeks after NAFR. Investigators evaluated photographs of the patients to assess improvement, and patients evaluated their own improvement on a quartile grading scale. Acne severity scores decreased by 55 %, and 8 of the 10 patients reported significant (50–75 %) or marked (>75 %) improvement. They found that there were no adverse events in any patients, such as herpes simplex virus flares, keloids, scarring, persistent erythema, hypopigmentation, or permanent hyperpigmentation. The authors concluded that this triple combination therapy was a safe and effective treatment for patients with a variety of atrophic acne scars.

The Initial Consultation

It is of utmost importance to take time during the initial consultation to carefully evaluate and classify the each patient's scars and to develop a treatment plan that is appropriate. Patients should be given time to discuss their scars,

and to point out the features of the scars which are most distressing to them. A discussion should be held in which the patient understands the need for multiple treatment sessions over a period of time, the downtime associated with each procedure, and the unpredictability and in some cases unsatisfactory nature of results. By appropriately managing expectations and creating a treatment plan that addresses the specific concerns and the unique combination of scars of each patient, the chances of success and patient satisfaction can be optimized.

Conclusions

A variety of techniques are available to the skin surgeon for the treatment of atrophic acne scars. Almost all patients will benefit from a combination of procedures, either the same procedure performed multiple times or a number of different procedures performed on the same day or on different days. Table 1 lists the most commonly-used treatment options for acne scars and summarizes the possible combination techniques that could be used with each procedure. Because of the varied morphology of acne scars, even

Table 1 Common acne scar treatments with indications and possible combination protocols

Technique	Indications	Can be combined with	Notes
Ablative fractional laser resurfacing (AFR)	Superficial textural irregularity, color variation, superficial boxcar and rolling scars	Any other acne scar procedure, either on the same day or different days	Possible interaction between ablative zones and filler material placed intradermally If performed on the same day as excision than laser should be performed after excision but before placement of epidermal sutures
Non-ablative fractional laser resurfacing (NAFR)	Superficial textural irregularity, color variation, superficial boxcar and rolling scars	Any other acne scar procedure	Possible interaction between ablative zones and filler material placed intradermally Requires significantly more treatment sessions than AFR
Excisional procedures (punch, elliptical, en bloc excision of grouped scars)	Deeply atrophic scars, scars with poor skin at scar base (hypopigmentation, sclerosis)	Adjacent or separate scars can be treated with subcision, fillers, or focal TCA on the same day or different day	Wide undermining and pulling skin can improve adjacent rolling scars Can combine with AFR or NAFR; if performed same day laser is performed after excision but before placement of epidermal sutures
Subcision	Rolling acne scars	Adjacent scars can be treated with any other modality on same day	Suction post-operatively may increase efficacy Filling subcision pocket with exogenous or autologous material not predictable response
Soft tissue augmentation fillers	Hyaluronic acid or collagen for specific rolling scars Poly-L lactic acid or calcium hydroxylapatite for scars accentuated by volume loss	Any other procedure other than deep fractional laser	Possible interaction between filler material and deep ablative laser zones Mixed results when fillers performed at same time as subcision
Focal application of high concentration TCA	Ice pick scars, narrow boxcar scars	Adjacent scars can be treated with any other modality on same day	Requires multiple treatment sessions

within the same patient, a tailored treatment plan for each patient is more likely to result in improvement of the scars.

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