A Review and Update of Treatment Options Using the Acne Scar Classification System

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BACKGROUND  An unfortunate consequence of acne vulgaris is residual scarring that can negatively affect a patient’s quality of life.

OBJECTIVE  Jacob and colleagues have previously described an acne scar classification system based on acne scar pathology that divided atrophic acne scars into icepick, rolling, and boxcar scars, and this review will evaluate new and developing treatment options for acne scarring.

METHODS  A Medline search was performed on the various treatments for acne scars, and particular attention was placed on articles that used the acne scar classification system of icepick, rolling, and boxcar scars.

RESULTS  Therapies for acne scarring included surgical modalities, such as subcision, and punch excision and elevation, injectable fillers, chemical peels, dermabrasion, microneedling, and energy-based devices. In the past decade, there has been a trend toward using cosmetic fillers and energy-based devices to improve acne scarring.

CONCLUSION  There were few high-quality evidence-based studies evaluating the management of acne scarring. Many disparate acne severity scores were used in these studies, and the acne scar type was frequently undefined, making comparison between them difficult. Nonetheless, research into interventions for acne scarring has increased substantially in the past decade and has given patients more therapeutic strategies.

The authors have indicated no significant interest with commercial supporters.

Acne is a very common inflammatory disorder of the pilosebaceous unit that consists of comedones, inflammatory papules, pustules, and nodules involving the face, chest, and back.¹ The pathogenesis of acne is complex and involves inflammation and release of cytokines around the pilosebaceous unit, abnormal keratinization, increased sebum production, and Propionibacterium acnes.² An unfortunate sequelae of acne is residual scarring and disfigurement. Acne and acne scarring can have a detrimental impact on the quality of life and lead to feelings of embarrassment and low self-esteem.³

Jacob and colleagues⁴ have previously described a classification system to define atrophic acne scars into 3 basic types: icepick, rolling, and boxcar scars. This classification system has allowed a consistent and standardized definition of acne scars that has been adopted into clinical research and has aided in treatment regimens. Each of these scar types has been classified based on the underlying scar pathology. By classifying acne scars into distinct types, treatment options can be better tailored to each individual patient (Table 1).

Icepick scars are narrow (<2 mm) and extend vertically into the deep dermis or subcutaneous tissue.⁴ Because of the deep extension of icepick scars, conventional skin resurfacing options will not adequately treat these types of scars. Rolling scars have sloped and shallow borders with a normal skin texture at the base and are about 4 to 5 mm wide.⁴ These scars result from abnormal fibrous bands anchoring

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ISSN: 1076-0512 • Dermatol Surg 2019;45:411–422 • DOI: 10.1097/DSS.0000000000001765
the dermis to the subcutis, which produces a dell in the skin. Treatment is aimed at correcting the abnormal fibrous anchoring of these scars. Finally, boxcar scars are round to oval, or rectangular, depressions with sharply defined vertical edges that can be shallow (0.1–0.5 mm) or deep (≥0.5). Shallow boxcar scars, rather than deep boxcar scars, are more amenable to treatment with resurfacing modalities. Other scar types, including, hypertrophic, keloidal, and sinus tract scars are less common. In this review, we will provide an update on the treatment options available for acne scarring, focusing on the 3 types of atrophic acne scars.

### Cosmetic Fillers

In the past decade, there has been a rapid influx of cosmetic injectable fillers, from temporary hyaluronic acid (HA) fillers to semipermanent and permanent fillers (Table 2). Several of these cosmetic fillers have been used for atrophic acne scars to increase tissue volume in these lesions and to stimulate collagen production. Superficial rolling and boxcar scars respond best to cosmetic fillers and have been combined with subcision to enhance results. A recent Cochrane review found moderate-quality evidence for the efficacy of cosmetic fillers in atrophic acne scars.
Our article only summarizes the available treatment options for cosmetic fillers approved by the United States Food and Drug Administration (FDA); however, there are many injectables available internationally that can also be suitable for the treatment of acne scarring.

**Hyaluronic Acid**

Hyaluronic acid is composed of a water-retaining glycosaminoglycan polysaccharide, which is a naturally occurring component of the body’s connective tissue. Hyaluronic acids are temporary fillers that last for 3 to 12 months. Hasson and Romero showed that in 12 patients with atrophic scars from various etiologies treated with HA (Esthélis, Anteis, S.A., Geneva, Switzerland), 74% had good to excellent results 1 month after treatment. A 68% reduction in acne scars was seen in a recent study in 5 patients who had 2 treatments of HA in a modified vertical tower technique. Although few studies have been performed to investigate the use of HAs for acne scars, HAs are widely used by dermatologists to treat atrophic acne scars.

**Calcium Hydroxyapatite**

Calcium hydroxyapatite (CaHA; Radiesse, Merz Pharma, Frankfurt, Germany) is a semipermanent and biocompatible filler composed of 25- to 45-μm microspheres of synthetic CaHA in an aqueous gel containing water, glycerin, and carboxymethylcellulose. Calcium hydroxyapatite stimulates collagen production by invoking a local response of histiocytes and fibroblasts. In a study of 10 patients with acne scars who were treated with 1 to 2 injections of CaHA, 30% of patients showed greater than 75% improvement and 60% of patients showed between a 50% to 75% improvement in acne scars after 12 months. No improvement was seen in icepick scars.

**Poly-ß-Lactic Acid**

Poly-ß-lactic acid (PLLA; Sculptra, Galderma, Fort Worth, TX) is a nonimmunogenic and biodegradable synthetic polymer that induces the production of collagen by increasing the number of fibroblasts through a foreign-body reaction, which improves skin texture over time. Several injections of PLLA are needed to restore volume because of its biostimulatory mechanism of action. PLLA has been shown to improve acne and varicella scarring in an open-label prospective study with 20 patients. After 7 treatments, there was a cumulative reduction of 46.4% in the severity of the scars. Sapra and colleagues performed a study on the treatment of hill and valley acne scarring, also known as rolling scars, in 22 patients with 3 to 4 treatments of PLLA, and 54.4% of patients had very good results. A new modality of fractionated CO₂ laser–assisted delivery of topical PLLA led to a 33% improvement in atrophic scars, including acne scars, in 20 patients after a single treatment. Poly-ß-lactic acid necessitates the use of more treatment sessions than other cosmetic fillers but can produce sustained results for over 2 years.

**Polymethylmethacrylate**

Polymethylmethacrylate (PMMA) is a permanent filler composed of 20% PMMA microspheres, 30 to 50 μm in diameter, suspended in bovine collagen. PMMA adds volume to acne scars and stimulates collagen production, and it can be a cost-saving alternative to the temporary fillers because only one treatment is usually required. In 2015, PMMA became the only FDA-approved cosmetic filler for the treatment of facial acne scars. A pilot study using subcision followed by one treatment of PMMA (Artefill; Suneva Medical Inc., Santa Barbara, CA) in 14 patients showed a 96% improvement in acne scars by investigator ratings 8 months after treatment without adverse events. Karnik and colleagues performed a
controlled and blinded study with 147 patients with rolling acne scars who were treated with one injection Artefill or placebo, and improvement in acne scars was observed in 64% of patients treated with PMMA versus 33% of control subjects. The most common adverse effect was injection site reaction.

Cosmetic fillers provide a minimally invasive option to treat acne scars by adding volume to the scar and also stimulating collagen production to improve skin texture. They can also be used in combination with other laser procedures to achieve the best results (Figure 1). The literature evaluating the use of fillers for acne scars is limited, and more studies are needed to determine the optimal filler type and number of treatments for soft-tissue augmentation of acne scars.

**Subcision**

Subcision is a simple surgical procedure that was initially described by Orentreich and Orentreich in 1995. Traditionally, it involves the use of a tribeveled hypodermic needle to free the tethering subdermal fibrous bands that are responsible for rolling scars, although several other instruments have been used such as conventional needles and blunt blades (Figure 2). The needle is placed in a horizontal plane in the upper subcutaneous tissue and advanced in a gentle back and forth motion parallel to the skin to release the fibrous bands. This causes subdermal bleeding, and the formed blood clot creates a potential space in the tissue to elevate the skin within the scar tissue. Thus, when the area heals, new collagen is formed in a plane that is more even with the surface of the surrounding skin. Usually, several treatments are necessary. Adverse events include temporary swelling and bruising, and rarely subdermal nodule formation.

Subcision works best for rolling scars and is less effective for deep boxcar scars and icepick scars. Several studies have demonstrated subcision as a stand-alone therapy for acne scarring. A study with 34 patients who had undergone 1 to 3 subcision treatments reported downgrading of acne severity from severe and moderate grade acne to mild grade in 53% of patients with minimal side effects. Subcision has shown superior results to 100% trichloroacetic acid (TCA) chemical reconstruction of skin scars (CROSS) method in 20 patients with fewer side effects. Subcision has also been combined with other acne scar treatment modalities. Recently, subcision has been combined with the use of cosmetic fillers and nonablative 1,320-nm neodymium-doped:yttrium aluminum garnet (Nd:YAG) laser to enhance the appearance of scars and skin texture. Finally, although subcision has been shown mostly to reduce rolling acne scars, a recent study of 18 patients who underwent subcision with a blunt blade under tumescent anesthesia showed marked to moderate improvement in 15 of the 18 patients treated, and deep boxcar and icepick scars demonstrated partial leveling as well.

Subcision is a well-tolerated and effective procedure to treat rolling and shallow boxcar scars and can be combined with other treatments for acne scarring.

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**Figure 1.** Before (left) and after (right) 3 treatments with polymethylmethacrylate dermal filler and RF microneedling. Photo courtesy of Douglas C. Wu, MD, PhD. RF, radiofrequency.
Punch Excision

Punch excision is an excellent option for the treatment of icepick and deep boxcar scars. In this method, a punch biopsy instrument is used to remove deep atrophic scar tissue to the level of the subcutaneous fat and then closed with sutures. The scars should be at least 4 to 5 mm apart to prevent excess traction in the skin, or at least a 4-week interval between procedures can avoid these adverse cosmetic effects. For scars larger than 3.5 mm, elliptical or punch elevation is recommended for best cosmetic outcome. Although a new scar is formed in this method, it is usually less noticeable than the previous deep atrophic scar. Using a resurfacing procedure 4 to 6 weeks after punch excision can also improve the appearance of the scar. Punch excision can be safely and effectively combined with laser skin resurfacing on the same day for acne scarring.

Punch Elevation

Punch elevation is a useful tool for shallow and deep boxcar scars. This technique combines aspects of punch excision and grafting. A punch biopsy tool is used to excise the scar down to the subcutaneous fat, and the tissue is then elevated slightly above the plane of the skin and fixed into place with sutures or steristrips. During the wound healing process, the elevated graft retracts slightly to the surface of the surrounding skin to improve the appearance of the scar. As with punch excision, a resurfacing procedure performed 4 to 6 weeks after procedure can enhance results. Punch elevation and punch excision has been combined with CO₂ laser treatment and dermabrasion to effectively treat deep icepick scars. Recently, punch elevation combined with fractional CO₂ laser showed better results for acne scarring than fractional CO₂ laser alone.

Few studies exist in the literature examining the use of punch excision and elevation for acne scarring; however, they can be excellent options for deep icepick scars and boxcar scars.

Chemical Peels

A chemical peel is a quick outpatient procedure that can be used to treat acne scarring. Mild acne lesions and shallow atrophic acne scars can respond well to mild and medium depth peels, such as 20% to 35% TCA, alpha hydroxy acids, salicylic acid, and Jessner’s solution. However, these chemical peels usually work best for macular scars, have limited use for deeper atrophic scars, and should be used cautiously in darker-skinned patients because of the potential for pigmented alterations. Deep chemical peels have fallen out of favor for the treatment of acne scars because of their significant side effect profile, such as dyschromia and scarring.

In the past decade, chemical reconstruction using TCA (CROSS) has come into favor for icepick scars and has also been used for rolling and boxcar scars. In the CROSS method, high concentrations of TCA are applied on a sharp wooden applicator and then pressed firmly into the atrophic acne scars, and white frosting is observed. The high concentrations of TCA cause coagulative necrosis of the epidermis, and the resultant wound healing causes an increase in the production of collagen and improvement in scar appearance. The CROSS method allows for shorter recovery time than medium to deep chemical peels because the peel is applied to only select areas of the skin. Several treatments with TCA CROSS are usually needed, and the degree of clinical improvement is proportional to the number of treatments. This technique has been shown to significantly improve deep icepick scars, rolling, and boxcar scars. Tri-chloroacetic acid has been compared with the 1,550-nm erbium:glass laser in 20 patients with darker skin types, and both procedures were shown to be equivalent in efficacy for icepick scars, but the 1,550-nm

Figure 2. Tribeveled 18G hypodermic needle used for subcision.
erbium:glass laser was slightly more effective for rolling scars. Rare complications of TCA CROSS include dyschromia, erythema, scarring, and atrophy. Nonetheless, high-concentration TCA CROSS has been used in dark-skinned patients with minimal or without any prolonged pigmentary changes or scarring.

Optimal concentration of TCA and number of treatments should be tailored to patient response to each treatment and observation of possible side effects. Deep boxcar and icepick scars are especially hard to treat, and TCA CROSS can be a useful method to manage these lesions.

Dermabrasion

Dermabrasion involves the use of manual derm-sanding using sandpaper and hydrogen peroxide for hemostasis, or a rotating motorized hand piece attached to either a serrated wheel, wire brush, or diamond-embedded fraises to remove the epidermis and upper dermis. By removing the superficial layers of the skin, the wound healing process creates a smoother and more regular appearance of the scar, and new collagen is formed. Dermabrasion is useful for superficial atrophic acne scars, such as rolling or shallow boxcar scars, but is less effective for icepick scars.

Advantages of dermabrasion include improvement in the appearance of superficial atrophic scars with only one treatment. However, the dermabrasion technique is operator-dependent, and that the procedure is painful and requires local or general anesthesia. There is significant postoperative pain and a lengthy healing time lasting up to several weeks with prolonged erythema and postprocedural dyschromia. There are other resurfacing modalities that offer fewer side effects and have a quicker recovery time, such as fractional ablative lasers. Jared Christophel and colleagues demonstrated in a split-face study of scars from Mohs procedures that dermabrasion and fractional ablative CO₂ lasers produced similar improvements in scar appearance, but the fractional ablative CO₂ laser had a better side effect profile and quicker healing time.

Microneedling

Microneedling is an inexpensive treatment option for acne scars. It consists of a sterile rolling device with several fine sharp needles applied to acne scars to create multiple small micropunctures in the papillary to mid-dermis. By creating these small wounds in the dermis, a cascade of growth factors is initiated that results in collagen stimulation and production. As microneedling penetrates only to the depth of the upper dermis, it is most useful for shallow boxcar and rolling scars. A usual treatment course with microneedling consists of 3 to 5 sessions spaced 4 weeks apart, and results are seen in 3 months. Patients usually experience a moderate improvement in acne scar appearance.

Several recent studies have shown the efficacy of microneedling in the treatment of acne scars. El-Domyati and colleagues showed a 51% to 60% improvement of acne scars after 6 sessions of microneedling. In this study, skin biopsies were also performed before and after the microneedling procedures, and they showed a statistically significant increase in collagen Types I, III, and VII. When microneedling was combined with platelet-rich plasma or glycolic acid peels, improvements in acne scar appearance increased to 62%. A study comparing microneedling with fractional non-ablative erbium 1,340-nm laser in 46 patients showed improvement in both groups and no statistically significant difference between the 2 treatments. Approximately 14% of the patients in the laser group experienced postinflammatory hyperpigmentation, and no pigmentary changes were seen in the microneedling group.

Microneedling has shown benefit in the reduction of shallow boxcar and rolling scars and can be a good option for darker-skinned patients because there is a low risk of hyperpigmentation.

Platelet-Rich Plasma

Plasma-rich plasma (PRP) is an emerging therapeutic tool that consists of a preparation of the patient’s own concentrated platelets in plasma to promote
wound healing through several growth factors and cytokines present in the concentrate. Plasma-rich plasma has been used in several areas of medicine, including for tendon injury, chronic ulcers, and alopecia. Only a few studies have investigated PRP for acne scars, and they have shown that this treatment is safe and mild to moderate clinical improvement after intradermal or laser-assisted PRP delivery. Lee and colleagues treated 14 patients with acne scars with an ablative CO\textsubscript{2} laser, and on one side of the face applied PRP. They showed slightly faster healing and clinical improvement on the PRP-treated side. Nofal and colleagues compared intradermal PRP, TCA CROSS, and combination of PRP and microneedling for a mixture of atrophic acne scar types and showed that half of the patients had a one-grade improvement in acne and no difference between the treatment groups. Further research and comparative studies are needed to evaluate the efficacy of PRP for acne scars.

Radiofrequency

Radiofrequency (RF) is an evolving tool that was used initially in dermatology for skin rejuvenation. This device uses electromagnetic radiation to generate an electric current that heats the dermis causing neocollagenesis and skin contraction. Radiofrequency has decreased downtime and risk of scarring and infection compared with ablative lasers, and it can be safe to use in all skin types as it is chromophore-independent, unlike other energy-based modalities, such as CO\textsubscript{2} laser. The initial RF device was monopolar and has evolved into bipolar and later fractional bipolar RF (FRF) (Table 2).

The earliest studies using RF to treat acne scars were with the monopolar and bipolar RF devices. In one study, 22 patients with active cystic acne and acne scars were treated with a monopolar RF device for 1 to 2 sessions (TheraCool TC; Thermage Inc., Hayward, CA), and 82% showed an excellent improvement in acne. No side effects were observed, and there was no downtime after the procedure. Bipolar RF delivers a more focused current to the dermis than monopolar RF. A study by Montesi and colleagues used a new device that combined RF with FRF for acne scarring in 15 patients and showed a 73.4% reduction of the scars after 5 procedures. The investigators found that rolling and boxcar scars responded better than icepick scars. Ramesh and colleagues showed that FRF had good to excellent results in 22 of 30 patients after 4 sessions. Unlike the previous study, icepick scars responded better than rolling and boxcar scars. Gold and Biron used an FRF to treat 15 patients for 3 sessions and showed a 60% marked improvement in acne scars. Fractional bipolar RF was studied by Cho and colleagues in 30 patients treated with 2 sessions with a 73.3% reduction in acne scars. In addition, skin surface roughness improved, and there was a decrease in the size of facial pores. Adverse effects included pain with the procedure and transient erythema. Another study with FRF showed an improved appearance of scars.

<table>
<thead>
<tr>
<th>Table 3. Types of radiofrequency devices used to treat acne scars</th>
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<tr>
<td><strong>Radiofrequency (RF) Devices</strong></td>
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<tr>
<td>Monopolar RF</td>
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<tr>
<td>Bipolar RF</td>
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<tr>
<td>Fractional bipolar RF</td>
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without damaging the epidermal layer in all 31 patients after 4 sessions. As with previous FRF studies, a major adverse effect was procedural-related pain, even with nerve blocks, or topical anesthesia.

Of the RF devices available, FRF offers the best results for acne scarring. An improvement of 25% to 75% in acne scars can be expected after 3 to 4 sessions (Figure 3). Radiofrequency is a safe and effective approach to treat all 3 types of atrophic acne scars with limited downtime and adverse effects, but further studies are needed for optimal treatment parameters.

**Lasers**

Lasers are another popular treatment option for acne scarring (Table 4). They are grouped into the traditional ablative lasers that cause epidermal and dermal destruction and the less-invasive nonablative lasers that target the dermis but leave the epidermis intact. More recently, fractional laser resurfacing has been used for acne scarring and consists of delivering energy in microscopic columns of epidermal and dermal tissue. Each of these laser modalities has varying risks, downtime, and varying efficacy on the 3 atrophic acne scar types.

**Ablative Lasers**

The ablative lasers, CO$_2$ 10,600-nm and Er:YAG 2,940-nm lasers, are considered the gold standard for treating acne scars with a laser modality. They target water in the skin causing dermal injury, along with damage to the epidermis, and in this process create the formation of new collagen. The ablative lasers produce excellent results for acne scars. In one study, there was a 75% mean improvement in atrophic facial scars with high-energy pulsed CO$_2$ laser. A long-pulsed Er:YAG laser in a study with 35 dark-skinned patients for pitted facial acne scars showed good to excellent results in 74% of patients. However, postinflammatory hyperpigmentation occurred in 29% of patients, and all patients experienced prolonged erythema. Because of the long recovery time and side effects from ablative lasers and the development of new nonablative and fractional lasers with less downtime, ablative lasers have become a less popular option for the treatment of acne scars.

**Nonablative Lasers**

Nonablative lasers are a more noninvasive way to treat acne scars. Commonly used nonablative lasers include the 1,064-nm Nd:YAG, 1,320-nm Nd:YAG, and 585/595-nm pulsed dye laser (PDL) (Table 4). Nonablative lasers target tissues in the dermis by selective photothermolysis to stimulate collagen and dermal remodeling to reduce acne scar appearance. They work best for shallow boxcar and rolling scars and are less beneficial for icepick scars.

There have been several studies using different types of nonablative lasers for acne scarring with mild to moderate benefit, and usually 4 to 6 treatments are required. The 1,064-nm Nd:YAG laser is used frequently for acne scarring and has shown to produce a 20% to 50% improvement in these lesions. In one study, PDL has shown similar efficacy to the 1,064-nm Nd:YAG for acne scars with a mean improvement of...
about 18%. Wada and colleagues treated 24 Japanese patients with various atrophic scars with 5 sessions of the 1,450-nm diode laser, and 75% of the patients had moderate to marked improvement in acne scars. Patients with a combination of rolling and boxcar scars responded best in this study with minimal adverse events; however, one patient did have post-inflammatory hyperpigmentation. When nonablative lasers are compared with fractional ablative lasers for acne scarring, fractional ablative lasers overall produce better results albeit can cause more complications. Asilian and colleagues compared the fractional CO\textsubscript{2} and Q-switched 1640-nm laser in a study of 64 patients and found that the fractional CO\textsubscript{2} laser produced better outcomes for acne scars. Adverse events were similar in both laser groups and consisted of postinflammatory hyperpigmentation.

Nonablative lasers are becoming more popular for acne scarring because they have a faster post-procedural recovery time and a better side effect profile than ablative lasers. However, more sessions are required, and acne scar improvement may not match the level of the ablative lasers.

**Fractional Lasers**

Fractional lasers are divided into nonablative laser (NAFL) and ablative laser (AFL) and have been evaluated in several studies for the treatment of acne scars. Improvement in acne scarring for NAFL ranges from 25% to 75% in several studies, and some patients show greater than 75% improvement. The number of treatment sessions with NAFL is proportional to the degree of improvement. Sar-dana and colleagues classified each acne scar subtype and recorded the response of each scar to the treatment with the 1,540-nm fractional nonablative laser. After 6 treatments with the 1,540-nm fractional laser, boxcar and rolling scars were found to respond better than icepick scars, with a 52.9% and 43.1% improvement in boxcar and rolling scars, respectively, while icepick scars only responded in 25.9% of patients. The 1,550-nm erbium-doped fiber fractional laser has also been shown to be safe and effective in treating acne scarring with multiple sessions in Fitzpatrick skin Type IV to VI; however, some patient developed self-limited post-inflammatory hyperpigmentation. Some authors advocate using lower total treatment densities, decreased number of passes, and pre-treatment and post-treatment with hydroquinone in darker-skinned patients to decrease the risk of post-inflammatory hyperpigmentation.

Ablative laser has been evaluated for acne scarring by Jung and colleagues who performed a study to compare the optimal laser settings for the treatment of scars with a fractional CO\textsubscript{2} laser in 10 patients in a split-face study. They showed that high-fluence and low-density settings showed greater improvements in acne scar appearance than on the low-fluence and high-density settings. A study by Cho and colleagues compared one treatment with fractional CO\textsubscript{2} laser with a nonablative fractional 1,550-nm erbium:glass laser in a split-face randomized, blinded study for atrophic acne scarring in 8 patients. At the 3-month follow-up, the authors found that the fractional CO\textsubscript{2} laser produced better outcomes for acne scars.

### TABLE 4. Laser Modalities Available for Acne Scarring

<table>
<thead>
<tr>
<th>Traditional Ablative</th>
<th>Traditional Nonablative</th>
<th>Fractional Nonablative</th>
<th>Fractional Ablative</th>
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<tr>
<td>Ablative 10,600-nm CO\textsubscript{2}</td>
<td>1,320-nm Nd:YAG</td>
<td>Fractional 1,550-nm Er:glass</td>
<td>Fractional 10,600-nm CO\textsubscript{2}</td>
</tr>
<tr>
<td>Ablative 2,940-nm Er:YAG</td>
<td>1,064-nm Nd:YAG</td>
<td>Fractional 1,540-nm Er:glass</td>
<td>Fractional 2,940-nm Er:YAG</td>
</tr>
<tr>
<td>1,450-nm Nd:YAG</td>
<td>755-nm picosecond</td>
<td>Fractional 1,540-nm Er:glass</td>
<td>Fractional 2,790-nm YSGG</td>
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<tr>
<td>585-/595-nm PDL</td>
<td>Intense pulse light*</td>
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<tr>
<td>532-nm KTP</td>
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*Not a laser.
PDL, pulsed dye laser.

PDL, pulsed dye laser.
exhibited greater improvement scores and subject satisfaction than the NAFL, but this was not found to be statistically significant because of the small study sample. The fractional CO\textsubscript{2} laser also had more adverse events, such as erythema and crusting.\textsuperscript{84} Thus, although NAFL can produce excellent reduction in acne scars, multiple treatments are needed to reach the same effect as a single treatment with a fractional CO\textsubscript{2} laser (Figure 4).

Fractional lasers are a good option for acne scars, especially rolling and boxcar scars. The NAFL has fewer side effects and downtime than the AFL; nonetheless, NAFL requires more treatment sessions than AFL. Both the NAFL and AFL have been used in darker skin types, but caution must be exercised because there is a higher risk of postinflammatory hyperpigmentation in these patients.\textsuperscript{85,86}

**Conclusion**

A myriad of treatment options are available for the 3 atrophic acne scar types, but there is a paucity of high-quality clinical studies for many of these therapies.\textsuperscript{8} Furthermore, the studies use many disparate acne severity scores, which make comparison between them difficult. In daily practice, combinations of these various therapies are used, and correct patient selection for each treatment modality is necessary to obtain optimal results.

**Acknowledgments**

The authors thank Dr. Mitchel P. Goldman and Dr. Douglas C. Wu for providing patient photographs.

**References**


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