Acne Scarring: A Review of Cosmetic Therapies

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Practice Points

- Scarring is a common and undesirable outcome of acne vulgaris that can occur even in the setting of appropriate medical management.
- Acne scars can be classified into several different types based on scar quality and appearance. The choice of treatment with medical or surgical measures should be made with respect to the type of scar present.
- A combination of therapeutic modalities often is necessary to achieve optimal cosmetic outcomes in the treatment of both atrophic and hypertrophic acne scars.

Acne vulgaris is one of the most commonly encountered skin conditions and frequently is seen in both adolescent and adult populations. Scarring is a common result of acne and may take the form of atrophic or hypertrophic scars. Acne scarring often occurs in highly visible areas such as the face, thus resulting not only in an undesirable cosmetic appearance but also potential impairment of mental health, social functioning, and overall well-being. There is a wide variety of medical and surgical therapies available for treatment of acne scarring. In this article, we review some of the most commonly used cosmetic therapies for acne scarring, including dermabrasion, laser resurfacing, radiofrequency (RF), subcision, skin needling, punch techniques, chemical peels, soft-tissue augmentation, intralesional therapy, cryotherapy, and silicone dressings, with a focus on cosmetic outcomes.

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Acne vulgaris is one of the most common inflammatory dermatoses affecting nearly all adolescents and a large proportion of adults.[1] Incidence rates trend downward with age, but prevalence has been reported to be as high as 51% in individuals aged 20 to 29 years.[2] Notably, recent evidence suggests there is an increasing incidence rate of acne among postadolescent women, with the severity associated with the menstrual cycle.[3,4] Scarring is a common result of acne and may even occur in the setting of appropriate medical therapy. In particular, some form of facial scarring has been reported to occur in up to 95% of acne patients, with severe scarring in 30% of these patients.[5] The detrimental effects of acne scarring are not only limited to impaired cosmetic appearance, as it also has been associated with depression symptoms, suicidal ideation, mental health problems, and general social impairment.[6] Given the negative impact of acne scarring on overall health and well-being as

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well as its permanent nature, early and effective treatment is essential to maximize cosmetic outcomes and minimize long-term deleterious effects.

Acne scarring can be broadly divided into 2 major categories: atrophic and hypertrophic. Atrophic scarring is more common and is characterized by an overall localized reduction in collagen content. Clinically, atrophic scars present as depressions in the skin secondary to inflammatory fibrous contractions induced by acne. This type of scarring can be further divided into various subtypes based on morphologic criteria (eg, size, depth), such as boxcar, ice pick, and rolling scars.[7] Conversely, hypertrophic scarring is characterized by an overall increase in collagen content and presents as firm raised lesions. Hypertrophic scars should be distinguished from keloid scars, as the former will not outgrow the margins of the original wound while the latter will.[8] Treatment of acne scarring is based on scar type and can be accomplished through a variety of medical and surgical modalities (Table). In this article, we review some of the most commonly utilized therapies for both atrophic and hypertrophic acne scarring with a focus on cosmetic outcomes. It is important to keep in mind, however, that the best treatment is to prevent the occurrence of acne scarring through early and proactive treatment of acne.[9]

Dermabrasion

Dermabrasion is a decades-old technique that employs the use of a motorized device equipped with an abrasive material to physically remove the superficial layers of the skin, thus inducing the wound-healing process with subsequent formation of new collagen.[10] In the same vein, microdermabrasion utilizes aluminum oxide crystals ejected from a nozzle to induce superficial microlacerations.[11] This technique is most successful when used to soften scar edges in superficial atrophic scars of the rolling or boxcar subtypes.[12] Dermabrasion has been shown to be equally as effective as laser therapy in the treatment of facial scars but is reported to have a much greater risk for adverse effects (AEs) (eg, erythema, edema) that may last for several weeks posttherapy.[13,14] Dermabrasion is a particularly operator-dependent technique for which outcomes may vary depending on operator experience. As such, it is not generally recommended as a first-line therapy given its risks and relatively modest results; however, dermabrasion can be a useful adjunct when performed in the right setting. This technique,

Modalities for the Treatment of Acne Scars

Scar Type	Morphology	Treatment Modalities
Atrophic	Depressions in the skin, reduced collagen content	
Boxcar	Round to oval, sharply demarcated vertical edges with a wide base (1.5–4 mm), may be shallow (0.1–0.5 mm) or deep (≥0.5 mm)	Dermabrasion (shallow), dermal fillers (shallow), lasers (ablative, nonablative, fractional; shallow), punch techniques (deep), RF (shallow, deep), skin needling (shallow), subcision (shallow)
Ice pick	Narrow (<2 mm), deep, may extend into dermis or subcutaneous tissue, steep edges	Chemical peel (CROSS technique), punch techniques, RF
Rolling	Wide (4–5 mm), shallow, undulating appearance	Dermabrasion, dermal fillers, lasers (ablative, nonablative, fractional), RF, skin needling, subcision
Hypertrophic	Raised firm lesions, confined to area of original acne lesion, increased collagen content	Cryotherapy, intralesional therapy (corticosteroids, 5-fluorouracil, bleomycin, verapamil), PDL, silicone dressing

Abbreviations: RF, radiofrequency; CROSS, chemical reconstruction of skin scars; PDL, pulsed dye laser.

in addition to laser resurfacing, should be used with caution in patients who have recently taken or currently are taking isotretinoin, as several case series have reported postprocedural development of hypertrophic or keloid scars,[15-17] but these findings subsequently were questioned in the literature.[18]

Laser Therapy

Laser technology has advanced tremendously over the last few decades and there are now a multitude of available lasers that are capable of variable depth penetration and energy delivery patterns. Common to all, however, is the ability to induce localized thermal damage with eventual collagen remodeling. Lasers can be divided into 2 major categories: ablative and nonablative. Ablative lasers cause epidermal destruction, while nonablative lasers are able to selectively target dermal layers without disrupting the overlying epithelium. Generally speaking, ablative lasers are more effective than nonablative lasers in the treatment of atrophic scars, with reported mean improvements of up to 81%.[19] This increased efficacy comes with an increased risk for AEs such as postinflammatory hyperpigmentation, prolonged posttreatment erythema, and formation of additional scarring.[20] Both ablative and nonablative lasers can be applied in the more recently developed technology of fractional photothermolysis. With this method, noncontiguous microscopic columns of thermal injury surrounded by zones of viable tissue are created, which is in contrast to the traditional manner of inducing broad thermal injury. Fractional ablative lasers can achieve efficacy rates similar to traditional ablative lasers with a reduced risk for permanent scarring or dispigmentation.[21] Notably, recent studies have shown promising results for the use of fractional ablative lasers as a mechanism to enhance drug delivery of topically applied medications such as poly-L-lactic acid and triamcinolone acetonide in the treatment of atrophic and hypertrophic scars, respectively.[22,23]

Lasers also play a role in the treatment of hypertrophic acne scars with the use of nonablative pulsed dye lasers. These lasers cause selective thermolysis of dermal vasculature, and average clinical improvements in hypertrophic scars of 67.5% after a single treatment have been reported.[24] Temporary postoperative purpura and long-term hyperpigmentation are reported outcomes of this therapy.[20]

Radiofrequency

Nonablative radiofrequency (RF) is a relatively novel technique that creates an electric current in the dermis at preset depths to induce thermal damage and eventual collagen synthesis. There are a variety of modalities for which RF can be applied, but microneedle bipolar RF and fractional bipolar RF treatments offer the best results for atrophic acne scars. Improvements in scar appearance of 25% to 75% have been reported after several treatment sessions.[25] Better results have been reported in the treatment of ice pick scars as compared to more superficial scars,[26] but additional studies will be necessary to validate this claim. Adverse effects are largely limited to temporary erythema and posttreatment scabbing.[27]

Subcision

Subcision is a more physically intensive technique useful for treatment of superficial atrophic acne scars. This method involves the use of a small needle that is inserted into the periphery of a scar before being moved in a back-and-forth manner underneath the base of the scar to loosen the fibrotic adhesions that result in the depressed appearance of the scar. Additionally, loosening of the tissue and resultant bleeding creates a potential space for future collagen deposition during the subsequent wound-healing phase. Subcision has a reported success rate of 50% to 60% in the treatment of rolling scars, and prospective, randomized, split-face trials have indicated that the short-term outcomes of subcision are superior to dermal fillers while being equally effective long-term.[28,29] Of note, a small percentage of patients may develop a localized nodule at the site of treatment, which can be resolved with intralesional steroids.[11]

Skin Needling

Skin needling, also referred to as collagen induction therapy, utilizes vertical needle punctures rather than the horizontally directed punctures that are used in subcision and can be used to treat rolling and boxcar scars. Traditionally, a small roller equipped with rows of small needles typically ranging in size from 0.5 to 3.0 mm in length is passed over the skin using gentle pressure, puncturing the superficial layers of the skin to loosen fibrotic adhesions and induce collagen synthesis. This procedure may be repeated several times within a single session or over multiple sessions depending on the depth and quality of the scars. This technique has been reported to reduce scar depth up to 25% after 2 sessions.[30]

Punch Techniques

Punch techniques are useful for treatment of deeper atrophic acne scarring, for which most other treatment modalities are not particularly effective. A punch excision approximately equal to the scar size is first performed, which may then be followed by either

removal of the scar tissue with subsequent suturing, graft replacement of the removed tissue, or elevation of the already established scar tissue to the level of surrounding skin where it is then held in place by sutures or adhesive skin closure material. Success rates with this method are largely limited to case series, but punch techniques are reported to be efficacious, especially for treatment of ice pick scars. Risks for this method include graft failure, graft depression, and formation of sinus tracts.[31]

Chemical Peels

Chemicals peels traditionally employ the use of acidic compounds to strip away the outer layers of skin to variable depths depending on the concentration of the agent being applied. Chemical peels are not generally recommended for application in a nonspecific manner in the treatment of acne scars given the relatively mild cosmetic improvements seen and the high rate of AEs such as pigmentary alterations and additional scar formation.[12] Rather, clinicians should employ the CROSS (chemical reconstruction of skin scars) technique, in which peel agents such as trichloroacetic acid are applied in high concentrations only to areas of atrophic scarring. Use of this method can minimize AEs while simultaneously achieving high success rates, with excellent results in 100% (32/32) of patients after 5 to 6 treatment sessions.[32] This method has been successful for hard-to-treat ice pick scars.[33]

Soft-Tissue Augmentation

Soft-tissue augmentation is another effective treatment of superficial atrophic acne scarring that utilizes injections of collagen fillers such as hyaluronic acid, calcium hydroxylapatite, poly-L-lactic acid, silicone, and even autologous fat to replace lost tissue volume while simultaneously inducing collagen production via stretching of dermal fibroblasts.[34] These treatments may require multiple sessions for cosmetic improvement but have shown considerable efficacy in the treatment of atrophic acne scars. Hyaluronic acid has been reported to be particularly effective for rolling scars.[12] However, these compounds only provide temporary results, thus requiring repeated treatments to maintain cosmetic outcomes. Permanent options include the recently US Food and Drug Administration–approved polymethylmethacrylate microspheres suspended in bovine collagen as well as the novel technique of autologous fibroblast transfer. These options are relatively new, but initial double-blind, randomized, controlled trials have shown minimal AEs with substantial improvements in 64% to 100% of atrophic scars treated.[35,36]

Intralesional Therapy

Intralesional corticosteroid injections are a mainstay treatment of hypertrophic acne scarring and are believed to exert their effects by decreasing fibroblast proliferation and promoting collagen degradation.[37] Treatment with steroids generally is effective, with reported improvement in 75% (6/8) of patients and complete flattening in 50% (4/8) of lesions according to one study.[38] Development of hypopigmentation, dermal atrophy, and telangiectasia are potential sequelae of this treatment.[37]

5-Fluorouracil, bleomycin, and verapamil also have been used with good results as intralesional treatments of hypertrophic scars, but these agents typically are reserved for cases of corticosteroid failure. Such compounds are thought to mediate their effects through inhibition of dermal fibroblast proliferation.[39] Results with these therapies are varied, but greater than 75% improvement is seen in most cases. Adverse effects include injection-site ulceration and hyperpigmentation.[39]

Cryotherapy

Contact cryotherapy has been studied as treatment of hypertrophic acne scars. The exact mechanism through which scars are reduced is unclear, but it is hypothesized that the physical damage caused by freezing and thrombosis lead to collagen restructuring. According to one study, cryotherapy was reported to achieve good or excellent results in 76% (29/38) of cases.[40] Permanent pigmentary alterations are a possible AE.

Silicone Dressings

Silicone dressings are a reasonable treatment option for hypertrophic acne scarring given their proven efficacy and minimal risk for AEs. Thin sheets of silicone gels or membranes are applied daily in a topical manner to acne scars and are believed to be therapeutic through a combination of pressure and hydration, which subsequently inhibits fibroblast production of collagen. Notable reductions in scar appearance and size are seen in 60% to 80% of individuals using this method.[41] Adverse effects are limited to pruritus and local skin maceration. Patient noncompliance may be an issue, as the silicone dressings may be applied on highly visible areas such as the face. Patients may apply the dressings at night, but efficacy may be reduced.

Conclusion

When determining which treatment options to use in a patient with acne scarring, it is important to first determine the patient's treatment goals while simultaneously establishing realistic expectations. Important factors to

consider are the patient's preferences regarding treatment risk, duration, and permanence, as well as budget and social or work requirements. As such, treatment plans for each patient should be determined on a case-by-case basis. It also is important to note that a combination of different treatment modalities often is necessary and superior to monotherapy in achieving satisfactory cosmetic outcomes.

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