

Management of Facial Scars

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Abstract

Keywords

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Scarring is a natural process of healing after damage to the skin that extends to the reticular dermis. While some scars may be socially acceptable, even admirable, scars of the face can be viewed as disfiguring or ugly. Minimizing the appearance of facial scars and optimizing their cosmetic outcome ideally begin before surgery or, in the case of trauma, at the initial reconstruction. Even when there has been poor initial healing, a scar's appearance can be improved. Herein, we review conservative, medical, and surgical therapies to improve the appearance of facial scars.

A scar is an unavoidable end result of wound healing, and facial scars can cause significant emotional distress due to their obvious location and perceived disfigurement.^{1,2} Rarely can scars be avoided or completely removed, but there are many ways to minimize their appearance and trick an observer's eye into overlooking or ignoring a scar altogether.¹ Scar management ideally begins with the initial reconstruction and closure, but there are many adjunctive therapies to improve a scar's appearance even after initial healing has taken place.

Etiology of Scars

Scarring is a natural process of healing after damage to the skin that extends to the reticular dermis. While some scars may be socially acceptable, even admirable, scars of the face can be viewed as disfiguring or ugly. Scars have many causes such as trauma, burns, acne, congenital (hemangioma involution), infections, and surgical excision.^{3,4} Understanding the cause of a particular wound or scar is paramount to appropriately managing it and optimizing the cosmetic and functional outcomes. For example, surgical revision of a scar caused by an underlying inflammatory disorder should be

delayed until the inflammation is quiescent or resolved, as revision in the setting of ongoing inflammation can lead to poor wound healing and excessive scarring.⁵ Similarly, surgical revision should occasionally be avoided in the setting of severe keloid development to prevent exacerbation of the process and worsening of cosmesis.

Wound Healing

The process of wound healing is often divided into four stages: hemostasis, inflammation, proliferation, and remodeling. Scar formation occurs in the latter two stages. Deposition of type III collagen, angiogenesis, and epithelial cell proliferation characterizes the proliferative phase, whereas deposition of type I collagen and fibroblastic growth characterizes the remodeling phase. Occasionally, the healing process produces hypertrophic scars or keloids.⁶

Scars are fluid over time; their initial erythema fades unless exposed to excess sunlight, and they contract unless exposed to external tension or movement.¹ Strength of scarred tissue gradually increases over time, eventually achieving a maximum strength an estimated 80% of natural, unbroken skin roughly a year after the healing process began.⁷

Preoperative Scar Management

If possible, risk mitigation in the preoperative period can improve the final cosmetic outcome. Smoking, for example, is associated with postoperative poor wound healing in addition to some medications and chronic conditions.⁸ Poor nutrition is also a risk for wound dehiscence and poor healing⁷ that can be mitigated prior to surgery.

Primary Scar Management

Optimal long-term cosmesis can often best be achieved in the initial reconstructive procedure.⁵ Revision procedures cannot always undo poor functional or cosmetic results of prior procedures. Thus, initial closure techniques, location, and suture materials should be considered.

Closure Techniques

In general, the first goal of reconstruction is closure of open wounds. Many techniques have been described within the framework of a reconstructive ladder to achieve wound closure, and ideal closure includes proper tissue alignment with careful tissue handling in a tension-free fashion.⁴

Beyond simply closing a wound, however, the reconstructive surgeon should also be sensitive to cosmetic considerations at the time of initial reconstruction. Scars will be more obvious to an observer if they traverse relaxed skin tension lines (RSTLs), distort facial subunits, develop an irregular texture along the scar surface, or create a significant color mismatch with surrounding tissue.¹ Scars located along subunit borders are less obvious. Also, scars that parallel (within 30 degrees of deviation) RSTLs are favorable (→Fig. 1). Long linear scars homogeneously reflect light and, as such, are obvious and unnatural. Closure with a geometric broken line or **W**-plasty technique can break up long scars into shorter lines, causing light scattering and leading to a scar that is less noticeable to observers.¹ A **W**-plasty, **Z**-plasty, or broken-line closure can also mitigate long-term scar contracture.

Scars contract in the process of healing, and if poorly oriented on the face can cause distortion of prominent features and perceived disfigurement. The expected healing and contracture of scars should be considered in the initial stages of facial reconstruction not only to improve overall endstate cosmesis but also to prevent functional impairment.

Wound Location Considerations

The face can be conceptually divided into multiple subunits (→Fig. 1) as a guide for initial reconstructive efforts.⁹ Different subunits have different thicknesses and compositions of overlying skin and subcutaneous tissue and have different unique considerations for wound closure.

Periorbital Scars

In the orbital subunit, poorly oriented scars can also cause severe functional impairment in addition to obvious disfigurement. Such is the case when scar contracture causes displacement of the eyelid, resulting in retraction, ectropion, entropion, or cicatrix.⁵ Eyelid malposition can be a precursor to exposure keratopathy, corneal irritation and scarring,

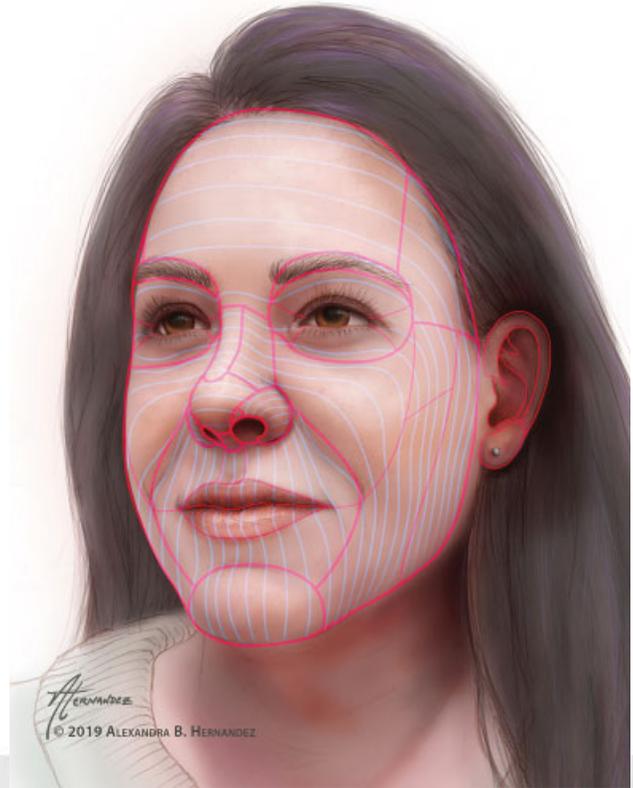


Fig. 1 Facial subunits and relaxed skin tension lines (RSTLs) of the face. Facial scars that lie along subunit borders and within 30 degrees of RSTLs are less noticeable and prone to improved healing.

infection, and even blindness.⁵ Consideration of the long-term effects of a proposed reconstructive method can improve the long-term cosmetic and functional outcome for the patient. The medial canthal area has a naturally concave surface, which makes this area uniquely suitable for healing by secondary intention in select cases (→Fig. 1).

Forehead Scars

Initial closure of forehead wounds should be sensitive to surrounding structures, specifically the hairline and eyebrows. Poorly designed advancement flaps and scar contracture over time can distort the natural hairline or eyebrow contour. Next, given the generally convex surface of the midforehead, concave scars will be particularly obvious in this area.¹ The temporal subunit can have a concave contour, however, which makes this area amenable to healing by secondary intention in some cases (→Fig. 1).

Perioral Scars

Scars that disrupt the orbicularis oris can cause functional impairment, but, more commonly, poor approximation of wounds that cross the vermillion border leads to obvious and displeasing scars of the perioral region.⁴ In this region, care should be taken for very precise realignment of the vermillion, when possible. If treating a scar that has had poor vermillion alignment, surgical revision is a necessary initial step.

Suture Material

Suture has long been believed to play a part in scar development and overall cosmesis. Absorbable materials, by their nature, create more inflammation and, thus, can theoretically lead to a poorer healed appearance of a wound. Furthermore, they may worsen hypertrophic scar or keloid development in some individuals. Permanent suture materials are, by their nature, more inert, inciting less inflammation in the wound bed, and therefore, theoretically, allow for better long-term cosmesis. They require a second visit, however, for removal; therefore, many studies have attempted to answer what the true difference in cosmetic outcome is between permanent and absorbable suture used for skin closure on the face. A recent meta-analysis by Gillanders et al compared 11 such studies evaluating more than 700 patients.¹⁰ Overall, no difference in the rates of hypertrophic scar development, excessive inflammation, infection, dehiscence, development of “train tracks,” or overall cosmesis was demonstrated between permanent and absorbable sutures.¹⁰ Of note, the study noted that there is no universally accepted objective cosmetic wound assessment scale that makes interstudy comparison difficult.¹⁰

Secondary Scar Management

Scars rarely can be removed completely; therefore, long-term management strategies primarily focus on scar effacement and camouflage.¹¹ There are many conservative measures, medical scar modulators, and surgical methods to improve the appearance of a facial scar.

Conservative Measures

Scars tend to heal over the course of several months, up to a year, and conservative actions taken within the healing period can affect how a scar heals and, potentially, obviate the need for further interventions. Facial scars should be protected from sun exposure, even in cloudy or overcast conditions. Scars are more susceptible to sun damage, and sunlight can cause persistent erythema or dyschromia. A daily moisturizer with SPF 30 or greater can help protect facial scars from sunlight, in addition to frequently wearing a hat or other physical barrier between the scar and the sun. Next, regular massage, beginning 3 or more weeks after surgery, can help to soften facial scars and prevent hypertrophy and contracture.

Resurfacing

Skin resurfacing, accomplished by many modalities, has been shown to improve contour and color irregularities in skin. In general, resurfacing techniques selectively remove the epidermis or epidermis plus papillary dermis and allow natural reepithelialization to occur. There are many modalities for accomplishing resurfacing, including light amplification by the stimulated emission of radiation (LASER) and dermabrasion.

LASER

LASER technology has been successfully employed, either as monotherapy or combined with other modalities, to restore

natural, homogenous skin pigmentation and to reduce contour irregularities.^{1,8} LASERs are typically divided into non-ablative and ablative types and further divided based on the depth of penetration, chromophore, and whether they are used in a fractionated or an unfractionated way. In general, LASERs are more efficacious for Fitzpatrick types 1 to 3, and they should be used cautiously for types 4 to 6 given an increased risk of long-term hypopigmentation.¹

For scar revision, the most commonly used LASERs are CO₂ and Er:YAG (erbium-doped yttrium aluminium garnet laser), the chromophores of which are collagen and water.¹ When used in an ablative setting, these LASERs are effective in treating hypertrophic scars and keloids, often when combined with intralesional steroid injection.¹ Nonablative LASERs, such as Nd:YAG (neodymium:YAG) and pulsed dye, target hemoglobin and are theorized to stimulate extracellular matrix deposition. As such, they are best suited for persistently erythematous (red) scars and those that are depressed or atrophic.¹

LASERs are not without their risks, however, and LASER safety protocols should always be attended. LASERs can cause severe burns of the face and airway, though severe burns are thankfully rare. More commonly, however, LASERs are associated with prolonged erythema (estimated rates of 1% after nonablative therapy and 10% after ablative therapy), blistering, reactivation of a herpes simplex virus infection (estimated rates of 0.5–5%, less than 0.5% with prophylactic antiviral therapy), exacerbation of acne and milia (estimated rates of 5–10%), hyper- or hypopigmentation, and exacerbation of scarring.^{8,12–14} Fractional LASER protocols are associated with shorter recovery time and fewer complications.⁸

Dermabrasion

Dermabrasion is useful in leveling hypertrophic scars or keloids, smoothing subtle contour irregularities in other scars, and promoting extracellular matrix deposition.^{1,4} It commonly is performed with a diamond fraise, wire brush, or dermasanding sweeping perpendicular to the scar line in an effort to remove the epidermis and superficial dermis.^{4,15} Grossly, pinpoint bleeding signifies reaching the appropriate depth of the papillary dermis.^{4,15,16} Following intact adnexal structures of the reticular dermis allow smooth reepithelialization. Care should be taken not to injure the reticular dermis, as this can cause worsened scarring.^{1,4} Also, prolonged erythema and dyspigmentation are possible complications.⁴

Injectable Scar Modulators

Steroids

Intralesional steroid injections are a commonly employed modulator of scars. They are theorized to work by reducing collagen cross-linking and deposition, thereby preventing further scar formation.¹ Postoperative injection, immediately or delayed, can lead to decreased elevation and erythema of scars.¹ Additionally, steroids can be used as a first-line treatment for keloids and hypertrophic scars, potentially obviating the need for surgical or other interventions. Injected triamcinolone acetonide has been shown to flatten small keloids by 50 to

100% and decrease their rate of recurrence.¹⁷ For best results, triamcinolone acetonide is often injected on multiple occasions, with each injection at an interval of 6 weeks and coupled with massage of the lesion. Steroid injection should be used cautiously and monitored over time, however, as it can also cause hypopigmentation, skin depression, adipose atrophy, and, rarely, necrosis.^{1,16,18}

Nonsteroidal Medications

5-fluorouracil (5-FU) has been demonstrated to modulate scar contracture after intralesional injection.^{5,8,19–21} 5-FU is an antimetabolite theorized to reduce hypertrophic scar formation by reducing fibroblast proliferation and type 1 collagen production.^{5,22} Its injection into scar tissue is an off-label use, and 5-FU has been associated with anemia, thrombocytopenia, and leukopenia when injected intravenously.⁵ A recent review by Shah et al found that 5-FU injection into hypertrophic scars can rarely cause wound dehiscence, scar widening, or tissue necrosis, but it commonly does not have negative side effects.²³

Bleomycin is another injectable medication that can be used to treat hypertrophic scars and keloids.⁴ There is little research on bleomycin and scar management. It is a cytotoxic antibiotic that binds DNA to induce strand breakage, but the method by which it improves scar appearance is not clearly known. It has, however, shown beneficial effects on the appearance of hypertrophic and keloid scars in some studies.¹⁶

Injectable scar modulators can also be combined into multicomponent compounds with the goal of maximizing the effect of an injection while minimizing side effects and the number of injections needed.²⁴

Fillers

Intralesional fillers allow direct treatment with immediate improvement of depressed scars. The ideal filler would allow simple placement of material, have minimal side effects and donor-site morbidity, and last the longest. Injected materials include autologous fat and synthetic materials.^{1,4,25} They are easy to place in clinic with topical anesthesia. They can last for several weeks to months, but typically the filler material will resorb over time, necessitating multiple repeat treatments. Surgical tissue transfer of free muscle and fascia can lead to longer-lasting and even permanent results but may have donor-site morbidity and longer downtime.⁴

Botulinum Toxin

Injection of botulinum toxin is common to mitigate the appearance or development of rhytids, particularly in the upper third of the face. It can also be used perioperatively, however, to minimize muscle movement of the forehead, prevent excess tension across a healing wound, and maximize scar healing in that area.^{1,26} A recent meta-analysis demonstrated that botulinum toxin significantly reduced the width of hypertrophic scars, improved their appearance on visual analog scales, and improved overall patient satisfaction.²⁷ Botulinum toxin does not have an immediate onset of action; however, when used as an adjunct during scar revision, patients should undergo injection 2 weeks prior to surgical revision.¹

Topical Scar Modulators

Silicone sheeting can improve the color, texture, and thickness of facial scars including hypertrophic scars and keloids.^{4,8} Its mechanism of action is poorly understood, but some theorize it works by providing an occlusive, hydrating environment that improves oxygen tension.^{4,28} Also, topical imiquimod, an immunomodulator, demonstrated improvement in scar appearance. Topical imiquimod use is limited by its side effects, however, which include systemic flu-like symptoms.²⁸ Many scar creams are available, but their true effects are poorly studied in the literature. Some creams that promote vitamin E or onion gel application have not shown objective improvement in scar appearance when compared to petrolatum gel alone.²⁸

Other Adjunctive Therapies for Scar Management

Radiation Therapy

Radiation therapy has been used to treat keloids for many years.²⁹ Established keloids have low growth rates, and for this reason, the treatment of *established* keloids with radiotherapy is usually associated with only partial (but typically not complete) lesion regression as well as some improvement in irritation.³⁰ Immediate postoperative treatment of *resected* keloids, in contrast, has been associated with low rates of keloid reformation and has emerged as the preferred management approach.^{31,32} In a recent meta-analysis of more than 70 studies and more than 9,000 keloids, radiotherapy after surgery resulted in a 78% local control rate for all patients.³³ Keloids involving head or neck subsites have been noted to have even more favorable local control, with rates exceeding 90% when treated with surgery and postoperative radiation therapy.³⁴

Several successful radiation therapy strategies exist for the postoperative treatment of keloids,^{31,33} including external-beam radiation therapy (using superficial x-rays^{35,36} or electrons^{34,37}) and brachytherapy.^{38–40} Local control for resected keloids treated with radiation therapy may be dose-dependent, with higher radiation doses (e.g., biologically equivalent dose₂ > 60, such as 2,000 cGy in five fractions) resulting in lower rates of local recurrence than lower radiation doses.^{41,42}

Potential complications of radiation therapy are divided into acute (occurring during or shortly after completion of radiation) and late (developing months or years following completion of radiation) and are dose-dependent and generally mild.⁴³ The most prevalent acute side effect is transient desquamation, including erythema or pruritus. Late side effects can include hypo/hyperpigmentation or telangiectasia.⁴⁴ There is a trivial (<1%) risk of carcinogenesis associated with this treatment.⁴⁵

Surgical Revision

In some cases, scars are best managed with surgical excision. Scar excision allows reorientation, lengthening, and precise suturing. It effectively resets the clock of healing and, for some patients, may seem to be a step backward in the healing process, but it may be necessary for optimal long-term management. Scar excision and surgical revision should be considered

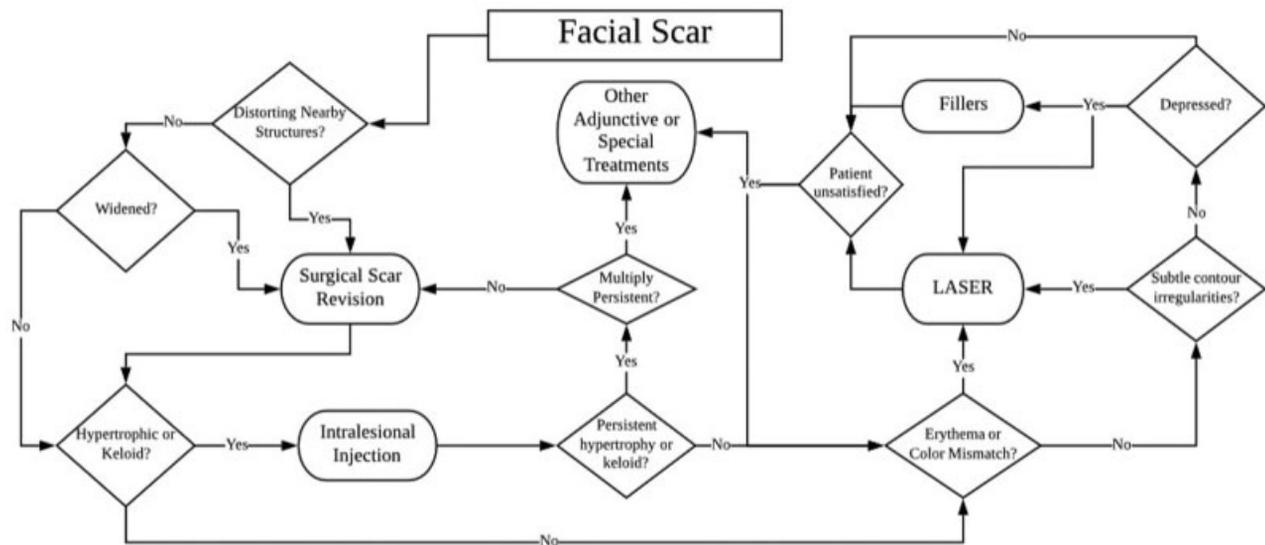


Fig. 2 Algorithm for the management of facial scars. If pursuing surgical scar revision, perioperative adjuncts such as botulinum toxin or intralesional steroid injection should be considered. Intralesional injections are most commonly steroids, but others such as 5-fluorouracil can be used as well. Adjunctive and special treatments include, for example, silicone sheeting, topical scar modulators, radiation therapy (for persistent keloids), and dermabrasion.

when there has been a previous misalignment of structures such as the vermilion border, hairline, or eyebrow. Excision should also be considered when scar lengthening is required, that is, when a scar is distorting nearby structures from contracture or when a scar can be reoriented into a more favorable position such as along subunit borders or parallel to RSTLs. Finally, it should be considered for widened scars and those with significant contour irregularities (hypertrophic scars, keloids) when excision will allow narrowing of the scar and smoother healing. Surgical revision should be followed by conservative and other adjunctive measures described previously for optimal long-term cosmesis.

Algorithm for the Management of Facial Scars

We propose the algorithm in ▶**Fig. 2** to help guide facial scar management. Initially, the surgeon should determine if surgical revision is needed to correct scar distortion of facial features (through misalignment or contracture) or to correct an overly widened scar. In the case of a hypertrophic scar or keloid, a trial of intralesional steroid injection should be undertaken, and if persistent, surgical revision can be considered. Following surgical revision and initial healing (aided by the conservative measures described previously), the surgeon should determine if secondary therapies are needed. LASER therapy can improve color and contour irregularities, and fillers can improve depressed scars. Finally, if there is persistent dissatisfaction with the scar's appearance, then other modalities (dermabrasion, silicone sheeting, topical creams, and other injectables) can be considered.

Conclusion

Overall, optimal scar management begins at or before the time of initial closure. Conservative measures employed in

the first 12 months of healing can improve a scar's appearance and mitigate the need for further therapies. There are many adjunctive medications and procedures for the management of facial scars, and our algorithm for the management of facial scars (▶**Fig. 2**) can aid in maximally improving scar appearance while minimizing interventions.

Conflict of Interest
None declared.

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