

TITLE: Scar Revision and Camouflage

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“Seven times turn your knife in your hand, ere you cut the skin of a fellow man.”

-- *Sir Harold Gillies*

Introduction

Scarring is an inevitable outcome of any wound that violates the dermis. This may be due to soft-tissue trauma, or it may be an iatrogenic injury. Any surgeon who operates on the face should be familiar with methods of designing incisions to minimize aesthetic deformity. Additionally, knowledge of scar revision principles can improve unsightly or functionally significant scars. We will focus mostly on the face, but many of the following principles apply to all soft-tissue surgery.

Wound Healing

An exhaustive review of wound healing is beyond the scope of this text. Briefly, however, after an initial injury, platelets and fibrin serve to achieve hemostasis. Next, neutrophils and macrophages populate the wound. This is the inflammatory stage of healing and occurs over hours to days. Bacteria are phagocytosed, and cytokines serve to mediate numerous changes.

This leads into the second phase of healing, which is the proliferative phase. Epithelial cells cover the wound, and fibroblasts lay down such products as proteoglycans, elastin, and collagen. Angiogenesis occurs, increasing the access of the body to the wound. This entire process occurs over several days.

The final phase of wound healing is the remodeling phase. Collagen is remodeled and reoriented. Myofibroblasts cause wound contracture. Tensile strength of the wound plateaus. This process will not be complete for approximately six months following injury.

Abnormal Wound Healing

Sometimes scars heal to form excessive tissue. This occurs in the form of either hypertrophic scarring or keloid formation. Although some feel that these represent a spectrum of disease, others feel that there are distinct ultrastructural and biologic modifiers at work. Additionally, much remains to be elucidated regarding the pathophysiology of these scars.

A hypertrophic scar is classically a red, raised, nodular, sometimes itchy or painful scar. It typically does not progress after twelve months, and it remains confined to its original wound. Otherwise it would be classified as a keloid. A keloid, (stemming from the Greek word for "crablike"), can progress and extend beyond the border of its wound. It has random, eosinophilic collagen whereas a hypertrophic scar has collagen oriented along the wound axis. Additionally, the hypertrophic scar does not have the same increased level of mucinous stroma or myofibroblast activity that the keloid does.

Treatment for these lesions, especially large keloids, remains difficult, as recurrence is common and may be worse. Options include excision, steroid injection, low-dose radiation, interferon, pressure dressings, and silicone application. Excision may be total, or, some feel, may be better served by a subtotal removal, as proponents feel that an intrascar incision heals better with less scarring. Also, many feel that laser excision leads to improved outcome versus cold steel excision. Steroid injection is known to be efficacious but may cause dermal atrophy and hypopigmentation. Also, cessation of steroid injections may cause resumption of keloid or hypertrophic scar formation. Low-dose radiation, although rightfully considered reservedly due to fear of long-term complications, has actually been one of the more efficacious modalities in preventing keloid recurrence. Interferon can be helpful but has systemic morbidity. Pressure dressings are known to be efficacious, perhaps through microvascular ischemia. Topical silicone sheeting is thought to have some effect on prevention of keloids through an ill-defined mechanism. Certainly the risk of silicone sheet application is low. In practice many practitioners use a combination of the above techniques.

Preoperatively

The best way to treat an unsightly scar is to prevent one. For example, many operations on the face can be hidden inside an orifice. Examples of these incisions include transconjunctival, sublabial, and intranasal approaches. If this is impossible, next one should consider hiding a scar behind an anatomical prominence or in the hairline. For example, a retroauricular incision for ear surgery is tolerated well by most patients. Submental incisions are also well-camouflaged. If this is not possible, one should attempt to place an incision into the junction of facial aesthetic units. An example of this that hides incisions very well is the melolabial crease at the junction of the cheek and lip subunit. Lastly, for incisions that are not addressed by the previous techniques, attempts should be made to place incisions in the relaxed skin tension lines (RSTLs).

The relaxed skin tension lines are a fundamental principle in soft-tissue surgery. An example will help to illustrate the concept. Imagine a square ship sail which has been unfurled in a calm wind, with a long weight at the bottom that holds the square sheet under tension. In this

scenario, one could cut a long vertical line in the sail without too much compromise of the way in which the sail lay. On the other hand, a long horizontal line would cause a large gap, and it would scarcely resemble the former sail.

Although the skin is folded in the complex three-dimensional anatomy of the human form, RSTLs exist in curvilinear space throughout the skin and vary little among individuals. Incisions parallel to the RSTLs will heal much better than incisions or lacerations perpendicular to the RSTLs.

Patient Encounter

A common emotion among patients who have unsightly scars is anger. Although the surgeon can often improve the scars, some amount of scarring will continue to exist. The same rules of engagement that one would use in an elective cosmetic operation apply, and a patient should be only offered surgery after it is determined that he or she has realistic expectations and is psychologically fit for this type of surgery. The patient also needs to understand that healing is a slow process, and that future “touch-up” procedures or adjunctive measures may be necessary down the road.

Finally, photodocumentation is necessary. Especially with scar revision surgery, standard exposure and lighting should be employed, as mild changes in the lighting or exposure can dramatically alter the photographic appearance of a scar for which no intervention has been undertaken. Specifically, tangential lighting that casts shadows will accentuate the scar, and overexposed “washed-out” photos will minimize the appearance of the scar.

Scar Evaluation

Occasionally a patient may request revision of a scar upon which the surgeon will be unable to improve. Short, narrow, flat scars fall into this category. Conversely, any scar which is long, wide, or raised/depressed may be a candidate for scar revision surgery. As a guideline, any scar that is wider than 2 mm or longer than 20 mm is a candidate. Also, relation to the RSTLs may influence a scar’s candidacy for and type of revision. A fresh scar in the RSTLs should be watched longer than an old scar perpendicular to them. As a general rule one should wait at least six months before revising a scar, but under certain circumstances one may proceed as early as six weeks.

Surgery

Raised or Depressed Scars

Raised, narrow scars may be amenable to a simple shave excision of the scar down to the level of the surrounding tissue. Deep or long depressed scars may be best treated by excision. For small depressed scars, such as from acne scarring, many advocate injection of a filler material to elevate the depressed area. Materials used include fat and collagen. Collagen has traditionally been bovine (necessitating skin testing to exclude allergy) but more recently

injectable human collagen has been developed. Alternatively, punch excision with primary closure works well for small acne scars.

Excision

Certain scars may be amenable to fusiform excision and direct closure. These would classically be short scars that are oriented in the RSTLs but which are unacceptable for some other reason. One example of this would be a tracheotomy scar. One should try to keep the angle at the end of the excision less than 30 degrees. Borges notes that the term “ellipse” is really incorrect, as an ellipse has no segment which tapers to a point⁶. For larger excisions which would require a long tapered segment, the surgeon may consider an M-plasty (see below).

Serial excision of scars may be appropriate for scars that are near an anatomical boundary or for large unsightly scars, such as after a split-thickness skin graft. For a scar that is oriented correctly near but not in a boundary line between facial aesthetic units, excision of the intervening skin may move the scar to a more camouflaged location. If the intervening skin is too much to excise in a single session without causing undue distortion, the tissue may be excised in a staged fashion, with post-operative massage and the passage of time allowing for tissue stretch and relaxation. Large areas covered by skin grafts may be reduced or eliminated over time as the staged serial excisions allow native tissue to expand and adapt to the new arrangement.

Z-Plasty

Any surgeon who performs reconstructive soft-tissue surgery should be familiar with the Z-plasty. The Z-plasty serves to **reorient** and **lengthen** a scar. As such, it is ideal for scars which are in an unfavorable orientation and are contracted.

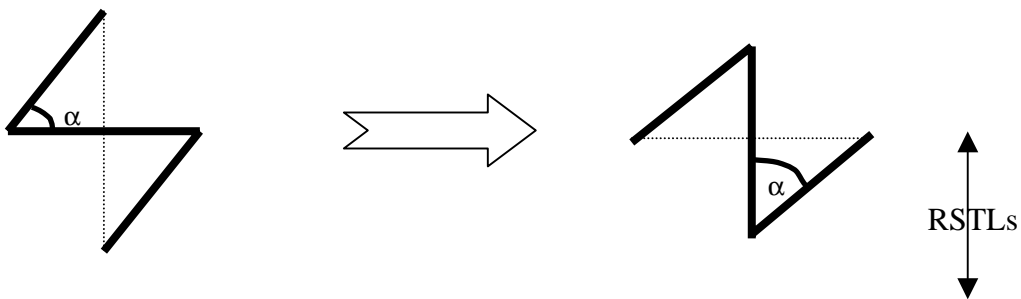


Figure 1. Z-plasty

Notice in the drawing of Figure 1 that the horizontally-oriented central segment on the left has been reoriented to a vertical segment on the right. Also note that the length of the horizontal dimension on the right figure has been increased relative to the horizontal length of the left figure. Thus, the two main functions of lengthening and reorientation are demonstrated. Note that the two triangular flaps are transposed relative to each other to effect the change.

In the drawing in Figure 1 the scar which is being revised would correspond with the horizontal segment and the RSTLs would pass vertically. As such, the unfavorably oriented scar is reoriented to the more favorable vertical dimension. Note that the diagonal segments could be designed in two ways: (imagine a compass) from southwest to northeast (as drawn) or northwest to southeast (not drawn). The orientation should be chosen in which the final diagonal segments lie more favorably with respect to the RSTLs. In Figure 1 it would not matter, but in the complex three-dimensional anatomy of the face it can. As an example, consider a scar perpendicular to the melolabial fold. A Z-plasty could reorient the scar to be parallel to the fold. Of the two possible designs, the diagonal limbs that run more vertically with respect to the lip (in RSTLs) would be superior to the alternate design in which the diagonal limbs would parallel the vermilion and cut across the RSTLs.

Notice that the length and angle of the long axis of the overall rhomboid shape (represented in Figure 1 by the dotted line) is dependent on the angle that the diagonal segments make with respect to the central segment (represented in Figure 1 by the character alpha). The more obtuse the angle, the more the original horizontal limb is lengthened after flap transposition. Table 1 lists the approximate increase relative to angle size. Angles less than thirty degrees should be avoided as one risks tip necrosis, and angles larger than sixty degrees make transposition of the flaps difficult due to tissue limitations. Angles larger than sixty degrees can be effected by bisecting them into smaller-angled flaps and performing a four (or even six) flap Z-plasty.

Angle (degrees)	Increase
30	25%
45	50%
60	75%

Table 1. Approximate increase in length relative to angle size.

Lastly, for long scars rather than performing a very large Z-plasty, one may consider breaking the scar into multiple shorter segments and performing a series of smaller Z-plasties.

W-Plasty and Geometric Broken Line Closure(GBLC)

One of the reasons that linear scars are unaesthetic is that the eye is drawn to straight lines. The principle behind both W-plasty and GBLC is to **irregularize** the scar. This serves to make the scar less noticeable. One principle to remember is that no segment should be longer than 6 mm as this may be more noticeable. Smaller segments are preferable, but segments less than 3-4 mm become prohibitively small. These techniques are usually suited for long scars. They may also be useful in planned incisions that out of necessity are perpendicular to RSTLs to irregularize the edges and provide small segments that are more in line with the RSTLs.

Unlike multiple Z-plasties, a W-plasty does not involve transposition of flaps. It merely serves as a regularly irregular closure of a scar. One should try and align some of the sides into the RSTLs as much as is possible. This technique is particularly useful on curved scars. Figure 2 shows the basic idea behind a W-plasty.

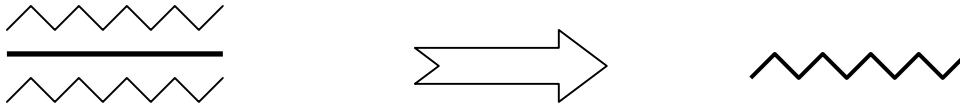


Figure 2. W-plasty

Although technically more difficult, the GBLC may be superior to the W-plasty because it is irregularly irregular. Similar in concept, the GBLC serves to irregularize the scar and thus make it more difficult to notice. Figure 3 shows the basic idea behind a GBLC.

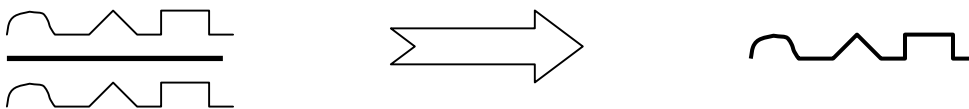


Figure 3. Geometric Broken Line Closure

M-Plasty

The M-plasty technique is useful for minimizing removal of normal skin and avoiding a long linear scar. When designing a fusiform excision, if the lesion is large it may necessitate a long excision of a triangular segment to create the fusiform defect (remember the angle on the fusiform segment should be less than thirty degrees). Instead, one can visualize a rhomboid at the base of the triangular segment and backcut along the rhomboid limbs. When closed this creates a “Y” type incision. Figure 4 details an M-plasty.

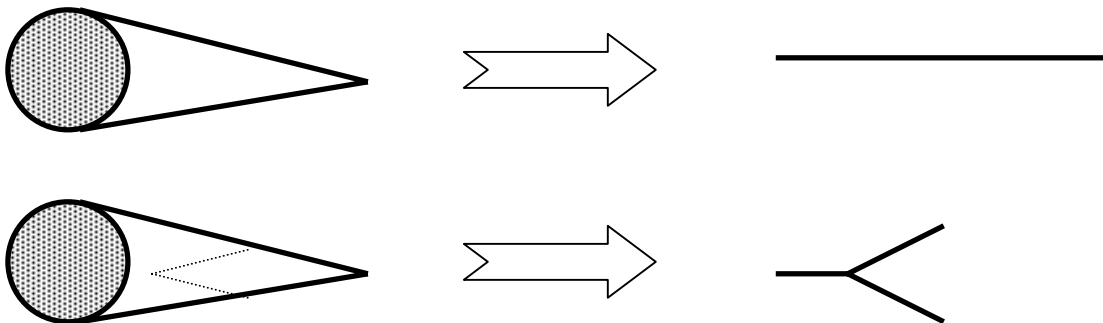


Figure 4. M-plasty

Adjunctive Measures

In addition to the above techniques, adjunctive measures may provide an improved ultimate outcome. Anti-tension taping will help minimize the stress across an incision and

therefore minimize any widening or tendency for hypertrophy of a scar. When mature enough, scar massage and sun protection are important in minimizing fibrosis and actinic damage to an already traumatized area of tissue. For early hypertrophy, steroid injections to the scar may help minimize overzealous healing. Early dermabrasion or laser resurfacing can help match a scar to its surrounding skin more evenly. The laser is especially useful for pigmentary changes. Finally, a good cosmetologist can help camouflage the scar with skin tone-matched makeup and other stylistic techniques that can help to minimize the appearance of a scar.

Conclusion

Scarring is an inevitable and necessary aspect of healing. Knowledge of skin physiology and biomechanics, facial aesthetic principles, and the surgical geometry of soft-tissue surgery can help minimize the scarring that we inflict on our patients or help revise the scarring that they endure from other causes.

Bibliography

- 1) Alster TS, Lewis AB, Rosenbach A. Laser scar revision: comparison of CO2 laser vaporization with and without simultaneous pulsed dye laser treatment. *Dermatol Surg* 24:1299-1302, 1998.
- 2) Berlinger NT. Wound healing. *Otolaryngol Clin North Am* 15(1):29-34, 1982 Feb.
- 3) Bernstein L. Z-plasty in head and neck surgery. *Arch Otolaryn* 89:574-84, 1969 Apr.
- 4) Borges AF. Principles of scar camouflage. *Facial Plast Surg* 1(3):181-90, 1984.
- 5) Borges AF. Timing of scar revision techniques. *Clinics in Plastic Surgery* 17(1):71-6, 1990 Jan.
- 6) Borges AF. Relaxed skin tension lines. *Derm Clin* 7(1):169-77, 1989 Jan.
- 7) Brown LA, Pierce HE. Keloids: scar revision. *J Dermatol Surg Oncol* 12(1):51-6, 1986 Jan.
- 8) Cantrell RW. Iatrogenic scar camouflage. *Facial Plast Surg* 1(3):191-208, 1984.
- 9) Davidson TM. *Scar Revision*. Self-Instruction Package (SIPac). American Academy of Otolaryngology - Head and Neck Surgery Foundation, Inc: Alexandria, 1998.
- 10) Farrior RT. Dermabrasion in facial surgery. *Laryngoscope* 95:534-45, May 1985.
- 11) Harmon CB, Zelickson BD, Roenigk RK, et al. Dermabrasive scar revision: immunohistochemical and ultrastructural evaluation. *Dermatol Surg* 21:503-8, 1995.
- 12) Kaplan B, Potter T, Moy RL. Scar revision. *Dermatol Surg* 23:435-42, 1997.
- 13) Koopman CF. Cutaneous wound healing: an overview. *Otolaryngol Clin North Am* 28(5):835-45, 1995 Oct.
- 14) McGillis ST, Lucas AR. Scar revision. *Dermatologic Clinics* 16(1):165-80, 1998 Jan.
- 15) Moran ML. Scar revision. *Otolaryngol Clin North Am* 34(4):767-80, 2001 Aug.
- 16) Nicolai JP, Bos MY, Smale CE. A protocol for the treatment of hypertrophic scars and keloids. *Aesthetic Plastic Surgery* 11:29-32, 1987.
- 17) Orentreich D, Orentreich N. Acne scar revision update. *Derm Clin* 5(2):359-68, 1987 Apr.

- 18) Paziienza LE. Cosmetology: an adjunct to aesthetic facial surgery -- a reconstructive aesthetician's perspective. In *Aesthetic Facial Plastic Surgery*. Romo T, Millman AI, (eds.) Thieme: New York, 2000.
- 19) Porter JP. Treatment of the keloid: what is new?. *Otolaryngol Clin North Am* 35(1):207-20, 2002 Feb.
- 20) Preuss S, Breuing KH, Eriksson E. Plastic surgery techniques. In *Plastic Surgery: Indications, Operations, and Outcomes*. Achauer BM, et al, (eds). Mosby: St. Louis, 2000.
- 21) Roenigk HH. Scar camouflage using dermabrasion. *Facial Plast Surg* 1(3):249-57, 1984.
- 22) Rudolph R. Wide spread scars, hypertrophic scars, and keloids. *Clinics in Plastic Surgery* 14(2):253-60, 1987 Apr.
- 23) Sherris DA, Larrabee WF, Murikami CS. Management of scar contractures, hypertrophic scars, and keloids. *Otolaryngol Clin North Am* 28(5):1057-67, 1995 Oct.
- 24) Stal S, Hamilton S, Spira M. Surgical treatment of acne scars. *Clinics in Plastic Surgery* 14(2):261-76, 1987 Apr.
- 25) Tardy ME, Denny J. Surgical alternatives in scar camouflage. *Facial Plast Surg* 1(3):209-25, 1984.
- 26) Tardy ME, Thomas JR, Pashcow MS. The camouflage of cutaneous scars. *Ear, Nose, & Throat Journal* 60:61-70, 1981 Feb.
- 27) Thomas JR, Ehlert TK. Scar revision and camouflage. *Otolaryngol Clin North Am* 23(5):963-73, 1990.
- 28) Thomas JR, Frost TW. Scar revision and camouflage. In *Local Flaps in Facial Reconstruction*, Baker SR and Swanson NA, (eds.) Mosby: St Louis, 1995.
- 29) Thomas JR, Holt GR. *Facial Scars: Incision, Revision, & Camouflage*. Mosby: St. Louis, 1989.
- 30) Webster RC, Smith RC. Scar revision and camouflaging. *Otolaryngol Clin North Am* 15(1):55-68, 1982 Feb.
- 31) Wolfe D, Davidson TM. Scar revision. *Arch Otolaryngol Head Neck Surg* 117:200-4, 1991 Feb.
- 32) Yang JY. Intrascar excision for persistent perioral hypertrophic scar. *Plast Recon Surg* 98(7):1200-7 1996 Dec.