Scar Revision & Camouflage

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Introduction

• Scarring
  – Dorland’s: a “mark remaining after the healing of a wound or other morbid process”

• Mechanism
  – Trauma
  – Surgical

• Location & orientation
  – Cosmesis
  – Function

Scarring is a result of the normal healing process. Many factors influence the final appearance of this process including the mechanism of injury, location of the injury, the initial management of the wound and any complications that occur during the healing process.
Ideal Scar

- Flat
- Narrow
- Good color match
- Parallel to or within skin crease

The ideal scar is level with the surrounding tissues, has a favorable color match, is narrow, parallel to or lying within a RSTL, and sinuous without long straight unbroken lines. Not all scars are able to be improved by revision techniques and those that are already optimal may be made much worse if a poorly thought out attempt at revision is undertaken. Patients should be carefully counseled to assure that their expectations are realistic – if they expect the scar to be completely gone - i.e. invisible – they need education or they are likely to be displeased with the outcome.
We will discuss several strategies that assist the surgeon faced with treating a previously formed scar, treating a wound that is likely to scar, or when contemplating inducing a wound on the face that is likely to scar. The most basic of these principles is careful planning of surgical incisions to minimize the cosmetic impact. Secondly, appropriate care of a traumatic wound or a post operative wound may lessen the scar formation. When a cosmetically unpleasant scar results and is mature, several options are available to render the scar less noticeable. While not elegant or involved, consultation with a cosmetics specialist may be all that is needed to achieve a pleasing result, and should not be forgotten as an option in the camouflage of facial scars.
Timing

• Traditionally 6 to 12 months
• Perhaps earlier for those perpendicular to tension lines
• Dermabrasion 6 to 9 weeks
  – High fibroblast activity

The timing of scar revision has traditionally been after the scar has had a period of maturation of 6 to 12 months. This allows time for scar maturation and better defines what needs to be accomplished in the revision. Patients often need to be counseled and reassured during this waiting period that the outcome is likely to be improved if appropriate time is taken for the scar to mature and the proper treatment selected.

Many would argue that scars lying outside RSTLs and especially those perpendicular to RSTLs are likely to have a poor cosmetic outcome and early revision and reorientation can be considered.

Dermabrasion is frequently performed at 6-9 weeks post injury utilizing the high fibroblastic activity in the wound at that time to aid in favorable wound healing.
Wound Care

- Steri-strips
- Wound cleansing
- Occlusive dressing
- Topical antibiotics
Steri-strips add strength to the wound during the critical time of deposition of collagen by fibroblasts in the first several days after wounding. Initially there is no inherent strength to the wound due to the absence of collagen extending across the wound. Suture material provides some apposition of the wound edges, but only at the site of each suture. Between sutures, there may be microscopic dehiscences of the wounds edges, thereby delaying healing and predisposing to a wide scar. Steri-strips applied to the wound serve to minimize this. Appropriately applied Steri-strips remove tension from the wound by sticking and pulling the skin distal to the wound margins. In general, they rarely last longer than 3-4 days at which point they should be removed and re-applied. When removing the strip, the two ends should be grasped and both sides removed toward the wound to avoid distracting the edges.

The wound should be cleansed in order to prevent the formation of crusts. The formation of crusts allows the colonization of accumulated serum or blood with bacteria thereby putting the wound at risk for infection. Antiseptics have not been shown to have any therapeutic benefit on the treatment of either clean or contaminated wounds. Anti-septics were designed to be used on intact skin and their effectiveness in this regard cannot be translated into effectiveness when used on open wounds. In fact, many are quite detrimental in the wound healing process causing an increase in the intensity and duration of the inflammatory response, gross and histologic evidence of tissue necrosis, and endothelial damage and thrombosis in an animal model. Special mention should be made of H2O2, a cleanser commonly used on wounds to reduce crusting and espoused by many authors. It is falsely believed that the effervescent bubbling of the solution is evidence of its antibacterial activity. It has been shown however, that its antibacterial potency is minimal at best. In addition, it can cause disruption of re-epithelialization by producing bullae under the new epithelium. It is also interesting that even a dilute 1:100 solution of H2O2 may be toxic to fibroblasts and impairs the microcirculation of wounds. It has been shown to delay wound healing in both humans and animals. (Branemark et al, J Bone Joint Surg. 49A:48, 1967). Given these adverse effects, it is perhaps most prudent to have the patient cleanse the wound with either sterile saline for plain tap water to remove any crusts that form.

The plane of migration of epithelial cells from the wound margin is determined in part by the water content of the wound bed. The epithelium seeks a plane of migration with a critical humidity. Open, dessicated wounds epithelialize much more slowly than moist, occluded or semi-occluded wounds. As demonstrated in this figure, migrating epidermal cells in air-exposed wounds moved beneath the crust scab and devitalized dermis to seek a plane with a critical moisture level. This route was a circuitous one taken with significant metabolic expenditure by the keratinocyte and consequently delayed wound re-epithelialization. In contrast, wounds that were kept moist had a level of adequate tissue humidity essentially at the wound base, thereby allowing for a more direct and speedier route of epithelialization. The practical message is that occlusive or semi-occlusive dressings optimally promote re-epithelialization.

The application of an occlusive dressing is useful, but may be difficult with many wounds of the head or neck. In addition, the dressing is only able to stay in place for several days due to the need for wound care. In our warm climate, where one cannot help but perspire approximately 11.5 months out of the year, these bodily secretions may accumulate under the dressing and along the wound edges to become an ideal environment for skin flora. Even if invasive infection is not the result, an increase in wound inflammation may result.

A good alternative is the “open” technique of wound care. The wound is covered with a generous amount of antibiotic ointment. This provides not only a moist wound environment, but also a barrier to dust and dirt contamination, as well as protecting the wound from contamination with skin oils and bacteria. The antibiotic ointment also provides some effect at the point at which the suture material pierces the skin, reducing the likelihood of the formation of stitch abscesses. For best effect, the antibiotic ointment should be replaced every 3-4 hours after a gentle cleansing and crust removal using sterile saline or tap water.

It may be difficult to employ both Steri-strips and antibiotic dressings. Many authors favor the open antibiotic dressing for fresh, primary wounds and steri-strips for scar revision or reconstructive wounds.
Wound Healing

- Inflammatory phase – hours
- Proliferative phase – days
- Remodeling phase – months
Wound Healing

[Diagram showing the stages of wound healing, including inflammation, granulation tissue formation, and matrix formation and remodeling.]
It is generally agreed that there are at least 3 phases of wound healing: Inflammatory or exudative phase, proliferative or granulation phase and wound contraction or remodeling phase.

**Inflammatory or Exudative Phase** – 0-3 days (begins immediately upon injury) disruption of blood vessels - influx of blood, serum proteins, platelets and clotting factors as well as collagen platelets initiate coagulation and release substances such as growth factors, fibrinogen, and fibronectin, all of which promote cell migration into the wound. 5-6 hours - neutrophils fight bacterial contamination 24-48 hours - monocytes or macrophages phagocytose bacteria and neutrophils releasing platelet derived growth factor and transforming growth factor beta needed to initiate granulation tissue formation.

**Proliferative or Granulation Phase** – 3-4 days to 30 days post injury rapid increase in fibroblast and epithelial cell mitoses, and increase in synthesis of extracellular collagen and proteoglycans re-epithelialization begins within hours but intensifies with rapid mitosis and new epithelial cells migrate along a bridge of fibrin when cells contact one another, migration ceases due to contact inhibition and keratinization begins most sutured wounds have epithelial coverage by 4 days post-injury angiogenesis follows fibroblast proliferation (begins at about 48 hours post injury) granulation tissue made up of fibroblasts, macrophages and new capillaries is the result collagen synthesis extremely active at 5-7 days.

**Wound Contraction (Matrix Formation) or Remodeling Phase** – begins approx 4 weeks and continues for 6-18 months characterized by reduction in fibroblasts, macrophages and wound vascularity Fibronectin eliminated as type I collagen accumulates later type III collagen forms with fibronectin myofibroblasts cause wound contraction (0.6 to 0.75mm per day) scar size is a function of wound tension, patient age, O2 supply to the area – mechanical stress promotes collagen synthesis and deposition leading to hypertrophic scarring hypoxia stimulates collagen deposition as well Contracts 0.6-0.75 mm/day.
Cellular Activity in Wound Healing
Wound Healing

- Keloid
- Hypertrophic scar
- Normal scar

Degree of scarring vs. Months
# Hypertrophic Scar / Keloid

<table>
<thead>
<tr>
<th>Hypertrophic scar</th>
<th>Keloid</th>
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<tbody>
<tr>
<td>Can regress</td>
<td>Does not regress</td>
</tr>
<tr>
<td>Oriented collagen</td>
<td>Random eosinophilic collagen</td>
</tr>
<tr>
<td>Confined to wound</td>
<td>Not confined</td>
</tr>
<tr>
<td>Scant mucin</td>
<td>Mucinous stroma</td>
</tr>
<tr>
<td>No myofibroblasts</td>
<td>Myofibroblasts</td>
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Hypertrophic Scarring
Keloid

- Pressure can lead to resolution
Keloids

- Described 1700 BC
- *Chele* – Greek for crablike
- More common in darker-skinned persons
- Most common age 10-30
- Usually after trauma
- Usually within a year
Keloids – Treatment

- Steroids
- Excision – Laser vs. cold
- Pressure
- Interferon
- Low-dose radiation
- Silicone Gel sheeting (hydrocolloid dressing)
- Combination
Patient Encounter

• Common reaction to scar is ANGER
• Counseling regarding expectations
• Counseling regarding timecourse
  – Cannot rush healing
  – Possible touch-ups later
• Photodocumentation
  – Consistent exposure and lighting
Scar Photography

Flat Lighting

Side Lighting
Scar Revision?
Good Candidate Scars

• Longer than 20 mm
• Wider than 1-2 mm
• Disturbing function
• Poor match to surrounding tissue
  – Color
  – Depth
• Against RSTLs
Hidden Incisions

• Hide incision in orifice
  – Transconjunctival, sublabial, intranasal, etc.
• Hide incision in hair
  – Bevel edges, be aware of future balding
• Hide behind anatomic prominence
  – Ex: retroauricular, submental
• Hide in junction of aesthetic subunits
• Hide in Relaxed Skin Tension Lines (RSTLs)
Relaxed Skin Tension Lines
Lines of Maximum Extensibility

- Lines of Maximum Extensibility (LMEs) are perpendicular to RSTLs
Relaxed Skin Tension Lines

- Somewhat mirrored by lines of aging
Relaxed Skin Tension Lines
Facial Subunits

Incisions may be camouflaged primarily by placing them at the junction of aesthetic subunits of the face. These occur where there is a contour change on the face or at the junction of non-hair bearing and hair-bearing skin. The shadows that are cast from the changes in contour tend to hide the scars well.
Facial Subunits – Example
Surgical Technique

• Adequate anesthesia
• Proper instruments
• Suture materials
• Closure of dead space
• Careful handling of tissue
• Precise closure of dermal layer
Technique

- Perpendicular incision – unless in hair-bearing area
Technique

Improper

Proper – everts
Depressed Scars

- Excision
- Injection
  - Fat
  - Collagen
    - Bovine
    - Human

Collagen allergy
Surgical Options

• Simple excision (fusiform)
  – Best for small scars that are wide or depressed
  – Ex: trach scar
  – Angle needs to be less than 30 degrees

• Serial excision
  – Based upon ability of skin to stretch over time
  – Can move scar to better anatomic location
  – Also good for reducing grafted areas
  – Alternatively, tissue expansion

• Shave – best for small raised scars
Serial Excision

- Scar could be moved via serial excision to hairline
Intramarginal Excision

- Hypertrophic scars
  - Incisions within scar may heal better
  - May be better than total excision
Intramarginal Excision
Z-Plasty

- Lengthens
- Reorients

The well-known Z-plasty technique of scar manipulation both lengthens and reorients the scar. It is especially useful in dealing with scars that cross important RSTLs, distort anatomic features, or create webs or bands across concavities. By spreading the forces acting on a given point over several directions, the Z-plasty helps to minimize distortions created by the strong contractile forces during wound healing. Thus, the Z-plasty may perform a cosmetic role by effacing a scar and may effect a functional improvement by the lengthening it provides.

The classic Z-plasty represented in this diagram has two 60 degree angles and three limbs of equal length. Undermining the two flaps created by incising these limbs and transposing them theoretically increases the length of the scar by 75%. The actual amount of lengthening is critically dependent on the elasticity and availability of the surrounding skin. In addition, increases in length from the rotated Z-plasty triangles vary depending on the angle between the central and peripheral limbs. Angles of less than 30 degrees may result in flap tip necrosis, those greater than 75 degrees in redundant standing-cutaneous cones.
Z-Plasty

- Keep angle > 30 degrees to avoid tip necrosis

\[ D = 2 \sqrt{\left(\frac{X - Z}{2}\right)^2 + Y^2} \]

Where
- \( X \) is the length of the central and lateral limbs
- \( \theta \) is the apical angles
- \( Z \) is \( X \cos \theta \)
- \( Y \) is \( X \sin \theta \)
- \( D \) is the new central limb length

<table>
<thead>
<tr>
<th>Apical Angle</th>
<th>Factor of Lengthening</th>
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<tbody>
<tr>
<td>30°</td>
<td>1.29</td>
</tr>
<tr>
<td>45°</td>
<td>1.43</td>
</tr>
<tr>
<td>60°</td>
<td>1.79</td>
</tr>
<tr>
<td>75°</td>
<td>2.05</td>
</tr>
<tr>
<td>90°</td>
<td>2.22</td>
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</table>
Z-Plasty
Z-Plasty

- Angles greater than 60 degrees can be broken into multiple flaps
Z-Plasty

- Angle should be no less than 30 degrees
- Optimally between 45 and 60 degrees
- Long scars can do with a series of Z-plasties
- Careful technique to avoid tip necrosis
M-plasty

• With a large standing cone, reduces amount of healthy skin excised
  – Ex: Lip, forehead flap
M-plasty

A. 

B. 

C. 

D.
M-Plasty

- Can advance tip with closure
W-Plasty

- Eye is drawn to straight lines
- Straight scars more likely to cause contracture
- W-plasty is regularly irregular
- Maximum segment length 6mm
- No. 11 blade helpful
W-plasty
W-Plasty

- Try to place segments in RSTLs
W-Plasty

- Helpful in curved scars
• Can use small $V \rightarrow Y$ segment to gain length
W-Plasty

- Correcting a design error
W-Plasty

- Gillies corner stitch may be helpful
- Others prefer simple stitch
W-plasty

- Note exposure on photos
Geometric Broken Line Closure

• Irregularly irregular
Geometric Broken Line Closure
Geometric Broken Line Closure

• After closing dermis can run with Fast-Sorb
Geometric Broken Line Closure
Adjunctive Measures

- Dermabrasion
- Laser
- Cosmetic camouflage
Dermabrasion

- Reduces surrounding skin to level of scar
- Blends color/texture
- Laser resurfacing now popular
- Best done around 6 weeks
Dermabrasion
Dermabrasion
Laser

- More control
- Good for pigment
- Minimizes particulate matter
- Optimum laser/combination under investigation
Laser
Cosmetics

• Very safe
• Allows sooner return to function
• May instead of or in addition to surgery
Cosmetics
Cosmetics
Treatment Algorithm
Conclusion

• “an ounce of prevention”
  – Surgical planning and technique
  – Wound care
• Counseling
• Timing
• Careful analysis
• Appropriate technique
Bibliography

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