Techniques for Scar Revision

Camysha H. Wright, MD
Faculty Advisor: David C. Teller, MD
The University of Texas Medical Branch
Department of Otolaryngology
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Anatomy of the Skin

• Skin is composed of three layers
  – Epidermis (generally 4 layers, except at palms and soles)
  – Dermis
    • papillary dermis (thin, loose collagen, blood vessels, fibrocytes)
    • reticular dermis (thick, compact collagen, sebaceous glands, and fibrocytes)
  – Superficial Fascia (fat cells, fibrous septae, blood vessels)
• At the dermal-epidermal junction there are rete pegs which anchor the epidermis to the dermis
• Rete pegs are lost in scar formation, can cause scar epidermis to shear off more easily than with normal epidermis
Anatomy of the Skin

Fig. 12-7. Diagram of vertical section of skin.
Anatomy of the Skin

Figure 1-5  The changes in the skin with time and scarring. (A) Young skin. (B) Aged skin. (C) Scarred skin.
Wound Healing

• Once a wound occurs, there are different phases of wound healing that occur
  – Vascular Phase (occurs immediately)
    • Early vasoconstriction (5 – 10 minutes)
      – Caused by platelet aggregation and fibrin
    • Vasodilation (can occur over hours to days)
      – Release of numerous cellular and acellular products in the blood, phagocytosis of bacteria and foreign material, migration of fibroblasts into the wound, subsequent production of new collagen)
Wound Healing

– Proliferative Phase
  • Reepithelialization
    – epithelial cells cover the wound, fibroblasts release products, angiogenesis begins
  • Granulation tissue/fibroplasia
    – inflammatory cells, fibroblasts, and neovasculature exist in a matrix of fibronectin and other glycoproteins
  • Wound contraction
    – centripetal movement of the wound edges
Wound Healing

– Remodeling Phase
  • Collagen is remodeled and reoriented
  • Myofibroblasts cause wound contracture
  • Tensile strength of wound plateaus
  • Process not complete for approximately 6 months or more
  • Ultimate goal to decrease bulk and improve tensile strength through the realignment of the collagen fibers
Wound Healing

Figure 2-2 Phases of wound healing.
Wound Healing

• Factors Influencing Wound Healing
  – Patient factors
    • genetic disorders, such as Ehlers-Danlos syndrome, osteogenesis imperfecta, and many others
    • metabolic factors such as diabetes mellitus or chronic renal failure
    • genetic “over-healing” states such as hypertrophic scars or keloids
Wound Healing

• Factors Influencing Wound Healing
  – Wound factors
    • infection
    • tissue trauma
    • tissue ischemia
    • wound closure techniques
    • wound dessication
Abnormal Wound Healing

• Abnormal “over-healing” wounds important to note with scar revision include:
  – Keloid formation
  – Hypertrophic Scars
# Hypertrophic Scar / Keloid

<table>
<thead>
<tr>
<th>Hypertrophic scar</th>
<th>Keloid</th>
</tr>
</thead>
<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>
</tr>
</tbody>
</table>
Keloids/Hypertrophic scars

- Treatment is directed toward inhibiting collagen overproduction
- Treatment includes:
  - Intralesional steroid injection
  - Surgical correction
  - Cryotherapy
  - Compression therapy
  - Irradiation
Keloids
Keloids
Fig. 18-10. A, One month postoperative view with some tissue reaction already developing. Ideally intralesional injection should have started earlier. B, Intralresional injection of the postoperative reaction. C, Postoperative view 6 months from the original surgery combined with preoperative intraleional injection, intraoperative intralresional injection, and early postoperative intralresional injection in a patient only moderately compliant regarding follow-up study.
Hypertrophic Scars
Hypertrophic Scars

- Intramarginal Excision
  - Incisions within scar may heal better
  - May be better than total excision
Scar Analysis

• Ideal Scars
  – Flat
  – Narrow
  – Good color match to surrounding skin
  – Lies parallel to relaxed skin tension lines or within a skin crease
  – Do not have straight, unbroken lines that can be easily followed with the eye.
Scar Analysis

• Scars to consider revision
  – Longer than 20 mm
  – Wider than 1-2 mm
  – Disturbing anatomic function or distorting facial features
  – Poor match to surrounding tissue
  – Lies against relaxed skin tension lines
  – Lie adjacent to, but not in a favorable site
  – Hypertrophied
Relaxed Skin Tension Lines

- Lines that follow the furrows formed when skin is relaxed
- Forces that cause RSTLs are inherent to the skin itself and the underlying collagen matrix
  - Correspond to directional pull that exists in relaxed skin
  - “Pull” largely determined by the protrusion of underlying bone and tissue bulk and frequently run perpendicular to underlying facial musculature
  - Constant tension on the face in repose, altered only temporarily by muscle contraction (incisions parallel to this thus heal better)
- Not visible features of the skin (unlike wrinkles)
- Can be found by pinching the skin and observing the furrows and ridges that are formed
Relaxed Skin Tension Lines
Timing of Scar Revision

• Generally, every scar will show improvement without revision for up to 1 – 3 years

• Traditionally we wait 6 to 12 months
  – Allows time for the scar to mature

• Perhaps earlier for those poorly positioned (perpendicular to tension lines) or those that are markedly uneven
Surgical Techniques

- Excision
- Z-plasty
- W-plasty
- Geometric broken line closure
Excisional Techniques

- Simple Excision
- Serial Excision
- Shave excision
Simple Excision

• Simple excision (fusiform)
  – Small scars that are wide or depressed and lie close to RSTLs
  – Hypertrophied scars
  – Angle at the end of the incision needs to be less than 30 degrees
Fusiform excision
Simple Excision/Scar repositioning
Serial excision

• Serial excision
  – Done based upon ability of skin to stretch over time
  – Can be used to move a scar to better anatomic location
  – Good for reducing grafted areas
  – Tissue expansion can be used in conjunction with serial excision
Serial Excision

- Scar could be moved via serial excision to hairline
Tissue Expansion

• More coverage obtained if placed in such a way that only normal skin is expanded
• General rule: the base of the expander should be approximately 2.5 – 3.0 times as large as the area to be reconstructed
• The three most commonly used expanders provide different amounts of expansion
  – Rectangular expanders generally provide the greatest expansion (38%)
  – Crescent shaped expanders provide 32%
  – Round expanders provide 25%
Tissue Expansion
Shave excision

- Shave – best for small raised scars
Z-plasty

• Can be used for:
  – Scar elongation
  – Release of scar contractures
  – To change direction of the scar (from perpendicular to parallel to RSTLs)
  – To change a displaced anatomic point, raising or lowering it

• Two triangular flaps are transposed relative to each other
  – Two arms that are of the same length as the common diagonal are extended from the ends in opposite directions
Z-Plasty

- Angle should be no less than 30 degrees and no more than 60 degrees
- Optimally between 45 and 60 degrees
- The more obtuse the angle the more the original horizontal limb is lengthened after flap transposition
- Long scars can be broken up with a series of Z-plasties
- Must use careful technique to avoid tip necrosis
Z-Plasty

- Lengthens
- Reorients
## Z-plasty

<table>
<thead>
<tr>
<th>Angle (degrees)</th>
<th>Length Increase</th>
</tr>
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<tbody>
<tr>
<td>30</td>
<td>25%</td>
</tr>
<tr>
<td>45</td>
<td>50%</td>
</tr>
<tr>
<td>60</td>
<td>75%</td>
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</table>
Z-plasty

A

B

UTMB
Multiple Z-plasty
W-plasty

- Excise consecutive small triangles on each side of a wound and imbricate resultant triangular flaps
- Employs segments with shorter limbs than z-plasty
- Does not cause overall lengthening of the scar
- Greatest usefulness on forehead, cheeks, chin, and nose (z-plasty more appropriate for eyes and mouth)
- Try and align some of the sides into RSTLs as much as possible, no flap transposition occurs
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

Figure 5-7  W-plasty. Running triangular flaps are interposed resulting in a regular irregular scar. A single long scar can be reoriented into small scars that are situated within the relaxed skin tension lines.
W-plasty
Geometric Broken Line Closure

• Series of random, irregular, geometric shapes cut from one side of a wound and interdigitated with the mirror image of this pattern on the opposite side
• All shapes should be between 5 – 7 mm in any dimension for improved camouflage
• Does not affect the length of the scar
• Well suited for scars that traverse broad flat surfaces (cheek, malar, and forehead regions)
• Useful for long, unbroken scars that cross RSTLs
Geometric Broken Line Closure
Geometric Broken Line Closure
Adjunctive Techniques

- Dermabrasion
- Laser Resurfacing
Dermabrasion

- Superficially abrades the scar and the surrounding skin to the level of the papillary dermis
  - if go too deep may cause depression which is difficult to repair
- Evens out irregularities along scar surface
  - improves appearance of uneven scar edges and raised grafts and flaps
- Best candidates have lighter complexions because of risk of postabrasion dyspigmentation
Dermabrasion

- One will first encounter pinpoint bleeding at the level of the superficial papillary dermis
- When white-colored collagen strands are observed, appropriate depth has been reached
- Blends scar color/texture into that of surrounding skin
- Best done around 6-12 weeks after surgical scar revision
Dermabrasion
Dermabrasion

Figure 5–10  (A) Pretreatment photograph of forehead scars (B) Two weeks after dermabrasion. (C) One year postoperative result from dermabrasion alone.
Laser Resurfacing

• Ablative Lasers
  – Can provide similar results to dermabrasion and may also result in pigmentary alteration
  – Can be combined with surgical scar revision for single step to allow reepithelialization and remodelling at the same time
    • laser treatment to surrounding cosmetic unit, followed by scar re-excision
  – Each laser has distinct advantages
    • Erbium:YAG – affinity to water, is more precise in ablating raised scar edges
    • CO2 laser - causes thermal necrosis, which promotes wound contraction and collagen remodeling
Laser Resurfacing

• Nonablative lasers
  – Improve scars without incision or wounding, minimizing down time
  – Heat collagen to improve appearance of scar
  – Optimum laser/combination under investigation
    • Flashlamp pulsed-dye laser used most extensively
      – Absorption by oxyhemoglobin caused direct destruction of the blood vessels and an indirect effect on surrounding collagen (can improve redness of scar caused by vascularity)
Laser Resurfacing
Laser
Algorithm for scar revision

Scar Revision Algorithm
Scar
→ Scar maturation

- Hypertrophic or Keloid
  - Large
    - Excision
      - Pressure or Radiation or Gel sheeting
    - Steroid injection or Interferon
  - Small
    - Excise

- Wide or Malpositioned
  - Moderate width
    - Serial excision
  - Large width
    - Local flap or Graft

- Distorted landmark
  - Yes
    - Excise
  - No
    - Reposition scar
      - Yes
        - Within RSTL
          - Yes
            - Scar contracted
              - Yes
                - Z-plasty
              - No
                - G-broken line or W-plasty
          - No
            - Dermabrasion or Laser resurfacing
        - No
          - Effacement
            - Depressed
              - Collagen injection
                - Alloderm
                - Fat/Dermis graft
            - Slight elevation
              - Shave excision
            - > 1 cm
              - G-broken line or W-plasty
Conclusions

- Scarring is inevitable and necessary aspect of healing
- There are many techniques that can be used for scar revision
- Appropriate knowledge and careful planning can minimize scarring or improve scars after scar formation has occurred
Bibliography