July 12, 2007: Scar Revision - Coclia

**July 12: Scar Revision**

**Preceptor: Tadros (Cornell)**

#1 (DJ) - Discuss when to revise a scar.

The indications for scar revision are often a matter of patient preference. Scars on the head and neck are distressing to most patients. However, certain aspects of a scar, such as the color or texture, may bother one patient more than another. A detailed analysis is extremely important as scars may be narrow, well positioned along aesthetic subunit borders, or in parallel with relaxed skin tension lines and will continue to mature, improve, and become less noticeable over a period of 12-36 months.

However, in many cases, patients will have scars that may be improved with surgery. The indications for scar revision include the following:

1. Widened scar – usually due to wound closed under tension
2. Scars perpendicular to or misaligned with the relaxed skin tension lines
3. Webbed/Contracted scar – usually traverse concavities
4. Pin-cushioned or depressed scar – caused by deep shave biopsies, deficient wound eversion, prior hematoma or infection
5. Hypertrophied scar/Keloids – caused by genetic predisposition, areas of motion or tension, or at a nidus of prolonged inflammation (e.g., infection or foreign body reaction)
6. Scars interrupting an aesthetic subunit of the face
7. Scars causing distortion of facial features or anatomic function

#2 (DL) Relaxing Skin Tension Lines (RSTL) and Lines of Langer

Langer first defined Langer’s lines by studying cadavers. He observed how a freshly inflicted circular wound took on an elliptical shape as rigor mortis developed. Langer’s assumption was that skin excisions oriented along the long axis of these wounds resulted in more favorable healing. Clinical experience has shown that this is not always accurate. Today Langer’s lines are of historical interest only.

Relaxed skin tension lines (RSTL) were described by Borges and are derived from vectors within facial skin that reflect the intrinsic tension of skin at rest. These properties are defined by the microarchitecture, such as the alignment of elastic and collagen fibers, and to a lesser degree, the influence of underlying bone and soft tissue bulk. RSTLs have the greatest cumulative effect on wound tension and final healing. The RSTLs are generally parallel to external skin wrinkles but represent a distinct entity from them and occasionally conflict such as at the lateral canthus, nasal supra tip and the glabella.

Lines of minimal tension, which are also known as natural skin creases or wrinkles, are the lines that are externally visible and result from repeated bending of skin from muscular contraction until a permanent cutaneous crease has formed with adhesions between the dermis and deeper tissues. The glabella, nose, and lateral canthal areas have conflicting RSTLs and lines of minimal tension where repeated muscular pull creates permanent skin creases that override the intrinsic tension lines of the skin. In these regions, it is usually best to orient wounds and scars with the skin creases rather than the RSTLs for best camouflage.

3. (AH) Describe the technique of Z-plasty. Draw and calculate the effect of 30-degree, 45-degree, and 60-degree Z-plasties.

Z-plasty is a technique for scar irregularization that is particularly useful for correcting scar contractures along anatomic concavities. This technique involves the transposition of triangular flaps on opposite ends of the scar. The end result is lengthening and changing the orientation of the original scar. Z-plasties can also be used consecutively along the entire length of a scar to allow for redistribution of forces and camouflage into surrounding RSTLs. The angle of the triangular arm can be adjusted to achieved the desired amount of scar lengthening. The "classic" Z-plasty uses a 60-degree triangle and results in 75% scar lengthening. The 30-degree and 45-degree Z-plasties lengthen the scar by 25% and 50%, respectively.
4. (DR) Demonstrate how to use a Z-plasty to lengthen a contracted scar, change the direction of a scar, break a straight line

Depending on the angle chosen, a Z-plasty can lengthen a contracted scar by as little as 25% (with a 30-degree angle), or as much as 75% (with a 60-degree angle):

In each case, the limbs of the Z-plasty are identical in length to the central arm (scar). The direction of the new scar will be at an angle \((x + 30)\) from the old one. Therefore, a 30-degree Z-plasty will rotate the scar 60 degrees, a 45-degree Z-plasty will rotate 75 degrees, and a 60-degree Z-plasty will rotate 90 degrees, i.e., be perpendicular.

A long, linear scar can be broken up with multiple Z-plasties, which can better camouflage its appearance among relaxing skin tension lines:

5. (KY) Describe the concept of geometric broken line closure and draw its use in scar revision

GBLC is an excellent technique of scar revision that creates an “irregularly irregular” scar without affecting the length of the scar. The geometry of the resultant scar is less predictable by the casual observer’s eye and thus frequently goes unnoticed. This technique is particularly well suited for scars that traverse broad flat surfaces such as the cheek, malar, and forehead regions.

![Figure 1 (Right)](image1)

The design of GBLC is a 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. The length of the geometric shapes is between 5 to 7 mm. Similar principles of undermining and leaving deeper scar tissue in the bed of the wound apply.

![Figure 2 (Left)](image2)
6) Describe the technique of dermabrasion. Discuss its use in scar revision. Limitations and complications of this technique.

Most commonly used for treatment of facial scars induced by acne, varicella, trauma, surgery, wrinkles, especially in the perioral and vermilion regions.

Dermabrasion is a mechanical method using abrasive surfaces to remove the epidermis and create a wound in the papillary or reticular dermis. This subsequently causes the stimulation of type I and III collagen and formation of a fresh layer of new skin with maximal effect seen at 12-18 months. There is a 10 to 14 day healing time, but expected drainage, swelling, discomfort and bruising can last 8-12 weeks. The modern electrical dermabrasion machine includes a hand piece with attachments for a wire brush, diamond fraise, or serrated wheel that rotates up to 33,000 RPM. The skin must be frozen before using the wire brush.

<table>
<thead>
<tr>
<th>Limitations:</th>
<th>Complications:</th>
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<tbody>
<tr>
<td>- facial scars can be improved but to entirely eliminated by dermabrasion</td>
<td>- skin gouges</td>
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<tr>
<td>- sun damage and wrinkles may only improve by 50-80%</td>
<td>- intraoral tears</td>
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<td>- Bad acne scars improve by only 30-40% or less</td>
<td>- hypopigmentation</td>
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<tr>
<td>- it cannot be used on the neck due to high risk of hypertrophic scarring</td>
<td>- hypertrophic scars</td>
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<td>and depigmentation caused by a significant decrease in adnexal structures</td>
<td>- prolonged erythema (beyond 4 weeks)</td>
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<tr>
<td>and thinner dermis.</td>
<td>- acne/milia</td>
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<td>- it cannot be performed within 6 months of accutane treatment</td>
<td>- infection</td>
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<tr>
<td>- it should not be performed on patients with deficient healing capacities,</td>
<td></td>
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<tr>
<td>collagen vascular disorders, and a personal history of keloids</td>
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<tr>
<td>- patients with prior history of skin resurfacing</td>
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There are several different non-surgical treatments of the keloid/hypertrophic scar. Block letters indicate side effects/complications of that treatment.

**Occlusive dressings:**
- Silicone gel sheets: independent of compressive forces, probably due added water retention in tissues due to occlusive silicone dressing. Hydration decreases collagen production by fibroblasts. (34% show excellent improvement, 37.5% mild improvement, 28% no improvement)
- Non-silicone occlusive sheets: 60% show flattening of keloid.
- Cordan tape: surgical tape with flurandrenolide (steroid) impregnated on tape. Shown to flatten and soften keloids over time.
- Ointments: provide occlusive effect, hydration. (Vitamin E has no improvement vs. placebo)

**Compression dressings:**
- Many kinds (button compression, pressure earrings, ACE, compression wraps, spandex, Lycra): thinning effect on skin, 60% show moderate improvement.

**Corticosteroids:**
- Mainstay of treatment. Reduce collagen synthesis, inflammatory mediators, and fibroblast proliferation during wound healing. Inject serially in 4-6 week intervals. 50-100% response to therapy, recurrence rate of 9-50%. ATROPHY, PIGMENT CHANGES, GRANULOMAS

**Other treatments:**
- IFN (alpha, beta, gamma): reduce fibroblast production of glycosaminoglycans (scaffold for collagen), increase collagenase production
- 5-FU: decreases fibroblast proliferation
- Doxorubicin: inactivates prolyl-4 hydroxylase in fibroblasts, inhibit collagen a-chain assembly. CARDIAC TOXICITY
- Bleomycin: necrosis of keratinocytes, PULMONARY FIBROSIS
- Verapamil: Blocks synthesis of collagen, GAGs), increases fibrinase
- Retinoic Acid: decreases keratohyalin synthesis, inhibits DNA synthesis.
- Imiquimod 5% cream: induces TNF-a, IFN, IL-1/4/5/6/8/12. MILD IRRITATION, HYPERPIGMENTATION
- Tacrolimus: inhibits TNF-a, gil-1 (oncogene overexpressed in fibroblasts of keloids)
- Tamoxifen: synthetic non-steroidal antiestrogen, inhibit proliferation of keloid fibroblasts and collagen synthesis. Decrease
TGF-a
- TGF-B3 (Justiva): reduces fibronectin, collagen I/III
- IL-10 (Prevascar): regulate fibroblast differentiation/proliferation, induce scarless healing when overexpressed
- Mederma® is formulated with Cepalin®, a proprietary onion extract that softens hardened tissue and reduces the size and redness of raised scars. Historically, onion extract has been used to soothe skin irritation and inflammation. Improves texture, color and overall appearance of scars.

Other therapies:
- XRT: controversial. Effective but is it safe? If XRT to follow surgery, 12 Gy is minimal dose.
- Cryotherapy: affects microvasculature, cell damage and tissue anoxia. REVERSIBLE HYPOPIGMENTATION, PAIN, PERMANENT DEPIGMENTATION

Laser:
- CO2 (10,600 nm): cut and cauterize lesion, dry surgical site, minimal tissue trauma. Solo recurrence rates 39-92%. With steroids, recurrence 25-74%
- Argon (488 nm): induce collagen shrinkage via heat. Recurrence rates of 45-93%.
- Nd:YAG (1064 nm): recurrence rates of 53-100%

8. (CY) When would you excise a keloid? How would you prevent a recurrent keloid?

Definition of keloid: an abnormal scar that grows beyond the borders of the initial scar

Most common regions of development: face (with cheek and earlobes predominating), upper extremities, chest, presternal area, neck, back, lower extremities, breasts, and abdomen.

When to excise:
The literature is not clear as to when to excise. Most authors advocate surgical consideration if the keloid becomes painful or very cosmetically deforming. Careful patient counseling is necessary prior to cold-knife excision due to the high recurrence rates from 45-100%.

Principles of excision:
1. Should be complete or near-total
2. Tension-free
3. Do not perform skin lengthening procedures such as Z-plasties.

How to prevent recurrence:
There is no clear answer as to the most effective method of recurrence. Some methods used described in the literature include:
1. Intralional steroid injections
2. Occlusive dressings
3. Compression therapy
4. Radiation
5. IFN, 5-FU, doxorubicin


PRS 1996;98:814
Study studies Vicryl vs. PDS II, two absorbable sutures, in wound outcomes. The former is braided, and the latter is monofilament. Sutures did not significantly differ in post-op erythema, scar hypertrophy, induration. Conclusion – no difference in sutures.

PRS 2001;107:38
Evaluated 1000 consecutive patients to eval factors associated with three outcomes: tissue reactivity, dehiscence, and infection. Suture size, and technique not associated with different outcomes, while pt sex, pt age, surgeon experience were mostly responsible for the above outcomes. No statistical difference in use of different suture types.

Conclusion: best suture? Vicryl vs. PDS II are equivocal. Since pt age&sex cannot be changed, surgeon experience most important.

9. Local Flaps for Scar Camouflage
Advantages of local flaps vs. grafts:
- Provide own blood supply, provide bulk and lining
- Contract less than grafts, <10%
- Better color match + undergo minimal pigment change
- Better coverage for bone and cartilage, may be composite

Advancement: Tissue undermined and advanced in straight line
E.g. Cheek Advancement Flap: May use to repair heminatal defects

Rotation: Axis of flap in plane different from defect
E.g. Nasolabial Rotation Flap: Very useful in facial repair, especially if donor site can be closed in straight line that is natural fold or landmark junction such as nasolabial fold or glabellar region

Transposition: Allow larger primary closure of the defect than other flaps, little tension on suture lines and minimize “dog ears”
E.g. Melolabial Bilobed Flap, Glabellar Bilobed Flaps: similar flaps designed to rotate ~90° using laxity and redundancy of skin. Good for intercanthal region.

E.g. Rhomboid Transposition Flap: Good for exposed areas of the nose, face and neck distant from favorable creases or junctional area of facial landmarks