Plastic Surgery Pearls for the Acute Care Setting

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Overview

- Optimal scar formation
  - Physiology and pathophysiology of wound healing
  - Suture selection
  - Adhesives
  - Tension alleviation
  - Wound edge eversion
  - Post-op care
  - Surgical scar revision

Overview

- Special problems
  - Complex wounds
  - The lips
  - The ears
  - The eyelids
  - The nose

Overview

- Each injury to our skin can result in a scar
- We must be:
  - Thoughtful in prevention
  - Meticulous in technique
  - Diligent in treatment
  - Committed in revision
  - A little lucky
  - And philosophically invested!

Overview

- Prevention
  - Skin physiology and wound healing
  - Technique for incision, excision, closure
  - Wound care
- Non-surgical therapy
- Surgical therapy (scar revision)

Physiology

- I. Inflammatory Phase (Immediate to 2-5 days)
  - Hemostasis, Vasocostriction, Inflammation, Vasodilation, Phagocytosis
- II. Proliferative Phase (2 days to 3 weeks)
  - Granulation, fibroblast proliferation, collagen production, neovascularization, Epithelialization
- III. Remodeling Phase (3 weeks to years)
  - New collagen formation, remodeling, contraction
## Pathophysiologic Factors

### Inflammatory Phase
- Infection, colonization, irritation → prolonged inflammation, erythema, granuloma

### Proliferative Phase
- Fibroblast and collagen hyper-proliferation, collagen production

### Remodeling Phase
- New collagen disorganization, overgrowth, contracture

## Pathologic Factors

- Factors contributing to poor scar formation:
  - Genetic predisposition
  - Darkly pigmented skin
  - Area of tension
  - Tissue trauma
  - Sub-optimal wound closure
  - Sun exposure
  - Poor wound care

## Characteristics of the Ideal Scar

- Flat and level with surrounding skin
- Match color of surrounding skin
- Narrow
- Parallel to favorable skin lines
- Sinuous or irregular without straight or unbroken lines

## Hypertrophic Scars

- Exaggerated growth of scar tissue remaining within confines of area of trauma

## Keloids

- Exaggerated growth of scar tissue, extending beyond the areas of trauma, projecting above the level of the surrounding skin

## Prevention

- Traumatic injuries:
  - Wound care
  - Thorough cleansing / disinfection of superficial wounds
  - Closure (sutures) of deeper lacerations to sub-cutaneous level
  - Moist, aseptic healing environment
**Closure**

- **Goal:** maximize scar camouflage
- **Preparation**
  - Strategic placement.
  - Clean field.
  - Appropriate suture.
- **Technique**
  - Gentle handling is critical.
  - Symmetry: depth, length, width.
  - Minimize tension—account for edema.
  - Appropriate stitch technique.
  - Evert skin edges.

**Clean Field**

- Remove gross debris from wound.
- Thorough surgical prep.
- For high risk wounds:
  - Pre-operative antibiotics.
  - Antibiotic irrigation.
  - Consider delay of closure for dirty wounds.

**Gentle Handling**

- Use of skin hooks to manipulate tissue.
- Fine atraumatic forceps.
- Avoid crushing skin edges.
- Minimize pressure to vascular pedicle.

**Strategic Placement of Incisions**

- RSTLs.
- Sub-unit borders.

**Perception theory – how do we see?**

- Active process involving selection
- We constantly (unconsciously) sort, select, and assign sensory information
- "Visual search" = process of distinguishing between 2 classes of signals:
  - Target signals (must be recognized)
  - Background signals (ignored)
Perception - visual search

Nature has provided us with the ability to respond to what is necessary, and ignore the irrelevant.
- If visual info resembles normal – we ignore and assume the rest.
- BUT – if abnormal, we consciously notice.
- We readily perceive the unexpected.

We unconsciously assume the expected, and consciously see the unexpected.

Perception

Goals for Wound Closure
- Symmetry
- Tension free
- Eversion
Closure

- The wound will contract in the months following closure.
- Must compensate for this with alleviation of tension and eversion
- Clip MJ

Deep layer closure.
Cutaneous layer closure.
Special techniques.
- Beveled incisions.
- Vertical mattress sutures.

Deep closure begins to evert wound.
Needle must capture tissue away from wound edge.
Keep skin edge mobile, untethered to deep closure.

Deep tissue approximation
- Minimizes tension
- Avoids subcutaneous dead space.
- Prevents inward contracture & wound inversion.

Adjust for uneven depth of edges.
- Differential depth of bites.
Closure

- **Eversion:** superficial closure
  - Needle must enter tissue perpendicular to skin or even pointed slightly away from wound.
  - Needle should capture same depth and width of tissue on opposite side and exit at same angle.

- **Simple Closure**
  - **Interrupted**
    - Allows for differential adjustment of wound edges.
    - More resistant to dehiscence with suture break.
  - **Continuous**
    - Standard—faster, evenly distributes tension along wound.
    - Locked—resists loosening, hemostatic, potential tissue strangulation.

Closure

- Eversion: bevel incisions to set up eversion.
**Closure**

- **Eversion: vertical mattress**
  - Allows for maximal eversion.
  - Keep inner bite very small to create hairline scar.

- **Vertical mattress**
  - Maximal skin edge eversion.
  - Alleviates tissue excess & dead space.
  - Reduces tension.
  - Ideal for thicker skin.
  - Minimize width of Inner bites.

**Skin Flap Physiology**

- **Undermining to reduce tension**
  - Mobilizes skin and soft tissue.
  - Helps to recruit tissue into defect.

- **Tension (stress) decreases up to a critical distance of undermining (4cm in pig model).**

**Sutures**

- **Selection based on tissue considerations and suture variables.**
- **The perfect suture:**
  - Favorable absorption profile.
  - Minimal tissue reaction.
  - Easy handling.
  - High tensile strength.
  - Resistance to infection.
**Absorbable Sutures, Natural**

<table>
<thead>
<tr>
<th>Type</th>
<th>Strength</th>
<th>Absorption</th>
<th>Filament</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plain gut</td>
<td>Str: 2/5</td>
<td>75% 7d</td>
<td>Twisted (virtual monofil.)</td>
<td>+++ tissue reactivity Hard to use</td>
</tr>
<tr>
<td>(animal collagen)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chromic (animal collagen)</td>
<td>Str: 2/5</td>
<td>75% 14d</td>
<td>Twisted (virtual monofil.)</td>
<td>+++ tissue reactivity Hard to use</td>
</tr>
<tr>
<td>Fast Absorbing Gut</td>
<td>Str: 2/5</td>
<td>75% 5d</td>
<td>Twisted (virtual monofil.)</td>
<td>+++ tissue reactivity Hard to use</td>
</tr>
</tbody>
</table>

**Absorbable Sutures, Synthetic**

<table>
<thead>
<tr>
<th>Type</th>
<th>Strength</th>
<th>Absorption</th>
<th>Filament</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vicryl</td>
<td>Str: 4/5</td>
<td>65% 14d</td>
<td>Braided</td>
<td>++ tissue reactivity Hard to use</td>
</tr>
<tr>
<td>Dexon</td>
<td>Str: 4/5</td>
<td>65% 7d</td>
<td>Braided</td>
<td>++ tissue reactivity Easy to use</td>
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<tr>
<td>Monocryl</td>
<td>Str: 4/5</td>
<td>65% 7d</td>
<td>Monofil.</td>
<td>++ tissue reactivity Easy to use</td>
</tr>
<tr>
<td>PDS</td>
<td>Str: 4/5</td>
<td>75% 14d</td>
<td>Monofil., polydi-oxanone</td>
<td>++ tissue reactivity Med. to use</td>
</tr>
</tbody>
</table>

**Nonabsorbable Sutures**

<table>
<thead>
<tr>
<th>Type</th>
<th>Strength</th>
<th>Comp.</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silk</td>
<td>1/5</td>
<td>Braided</td>
<td>+++ tissue reactivity Easy to use</td>
</tr>
<tr>
<td>Nylon</td>
<td>3/5</td>
<td>Monofil.</td>
<td>Min tissue reactivity Med. to use</td>
</tr>
<tr>
<td>Prolene</td>
<td>2/5</td>
<td>Monofil.</td>
<td>Min tissue reactivity Med. to use</td>
</tr>
<tr>
<td>Ethibond</td>
<td>3/5</td>
<td>Braided</td>
<td>Min tissue reactivity Hard to use</td>
</tr>
<tr>
<td>Steel</td>
<td>5/5</td>
<td>Monofil.</td>
<td>Min tissue reactivity Hard to use</td>
</tr>
</tbody>
</table>

**Closure**

- **Adhesives**
  - Cyanoacrylate adhesives.
  - Only for superficial layer closure.
  - Must have secure buried subcutaneous sutures to aid in edge eversion.
  - Evert wound edges prior to application.
  - Ideal for children.

**DERMABOND**

- Octyl-2-cyanoacrylate
  - Long-chain cyanoacrylate derivative
  - Less tissue reactivity
  - More flexible
  - Increased biomechanical strength

**CYANOACRYLATE ADHESIVES**

- Synthetic tissue adhesives
- Use limited to superficial skin closure
- Associated with tissue toxicity if implanted subcutaneously
  - By-products of degradation include cyanoacetate and formaldehyde
  - Shorter chain cyanoacrylate derivatives (ethyl and butyl) associated with greater toxicity
TECHNICAL POINTS

- Insure good hemostasis
- Careful preparation and handling of tissues
- Use of everting subcutaneous sutures will maximize cosmetic result
- Apply Dermabond on horizontal surface
- Use multiple thin layers of Dermabond

Subcutaneous sutures are critical to eliminate sub-Q dead space prior to application of Dermabond.

Skin closed with subcuticular suture and then applied Dermabond. Also Dermabond polymerized then suture pulled out prior to awakening patient from anesthesia.

Post-op

- Aseptic environment 1-2 days
  - Absorptive, occlusive dressing.
  - Antibiotic ointment.
- Reinforce with tape as necessary.
- Compression or drain for high risk wounds (extensive undermining, concavity).
- Early removal of sutures with replacement with tape.

Adjuvant procedures
- Taping
- Steroid injection
- Silicone sheeting
- Dermabrasion
- Scar revision
Topical Scar Prevention

- Post-operative wound care
  - Occlusive or semi-occlusive dressing to maintain moisture

- Sun avoidance!!
  - Limit sun exposure for one year+
  - Zinc fortified sunscreens (spf 40+)

- Alleviation of tension
  - Taping
  - Adhesives

- Silicone Gels
  - Sternal incisions: decrease pigmentation, pliability, pain and pruritis

- Silicone Sheets
  - May reduce hypertrophic scar
  - Mechanism unknown.
  - Optimal duration of use unknown (2d to 6 mo after injury)
  - Disadvantages: hygiene, frequent sweating, compliance. Need to change, clean and wash

- Mederma Skin Care Gel
  - Active ingredient: Allium cepa onion extract with derivative quercetin (a bioflavanoid)
    - antiproliferative and anti-inflammatory effects
  - 1999 pilot study: 97 patients db blind.
    - Pt. perceived increase scar softness
    - No change in scar erythema and pruritis.
Topical Scar Prevention

- Mederma Skin Care Gel
  - 2002 study in rabbits: Greater collagen organization on histology, No significant benefit on scar elevation, dermal vascularity, or inflammation.
  - 2004 in vitro study: Quercetin results in reduction in TGF-β, inhibits fibroblast proliferation, collagen production, and lattice contraction.

Surgical Scar Revision

- Fusiform excision and closure
- Scar camouflaging techniques: Z-plasty, W-plasty, Geometric Broken Line Closure
- Scar repositioning: V to Y advancement, Serial partial excision
- Composite grafting

Pearls for prevention by location

- Special problems
  - Complex wounds
  - The lips
  - The ears
  - The eyelids
  - The nose

Specific Types of Wounds

- Small stellate wounds converted into simple lacerations
- Trapdoor lacerations (tangential partial avulsion injury): leaving a U-shaped flap
  - Flap is small: excised & the surrounding tissue closed primarily
  - Larger flaps: replaced & closed to avoid a pincushion deformity
Closure

- Half-buried mattress
  - Useful to secure corner into angle.

Pearls for prevention by location

- For extensive wounds, not easily closed
- Healing by secondary intention
  - OK over solid convex surfaces
  - Not OK over concave areas, near facial landmarks

Specific Types of Wounds

Lip Injuries

- Layered closure: skin, sub-q, muscle, mucosa
- The skin & subcutaneous tissues repaired with careful eversion to prevent inversion deformities after wound contraction

Specific Types of Wounds

Lip Injuries

- Lacerations that cross the vermilion: a single monofilament "key stitch" is placed at the junction of skin & vermilion
- Avulsion up to 1/4 of the lip closed primarily without functional or aesthetic deficits
- > 1/4 of the lip tissue is lost: local flaps
Specific Types of Wounds

- **Lip Injuries**
  - Abbe & Karapandzic rotation flap \( \rightarrow \) defects of 40% to 60%
  - Defects > 60% require a check flap (the fan flap)
  - Near-total loss may \( \rightarrow \) distant pedicle or free-tissue transfer
  - Amputation of the lip presents + a viable amputated segment \( \rightarrow \) microvascular replantation

Specific Types of Wounds

- **Auricular Injuries**
  - Thorough irrigation, antibiotics (anti-pseudomonas)
  - Most auricular lacerations should be closed primarily, except for human bites, which are extensively contaminated & may benefit from 3 to 4 days of open treatment before delayed closure

Specific Types of Wounds

- **Auricular Hematoma**
  - Pathophysiology
    - Hematoma b/n cartilage and perichondrium
    - Devascularizes cartilage
    - Irritated perichondrium produces new cartilage
Auricular hematoma

- **Treatment**
  - Close incision
  - **KEY:** Pressure bolster 7-10 days

  ![Image of Auricular Hematoma](David W. Kim, MD Facial Plastic and Reconstructive Surgery, UCSF)

- **Complications**
  - Chondritis and perichondritis
  - Cauliflower ear

  ![Image of Auricular Hematoma Complications](David W. Kim, MD Facial Plastic and Reconstructive Surgery, UCSF)

- **Specific Types of Wounds**
  - **Eyelid and Lacrimal System Injuries**
    - Simple lacerations → repaired with 5-0 or 6-0 monofilament sutures → removed 5 days
    - Conjunctival portion is not severe → left open & closed with 5-0 or 6-0 buried absorbable suture (chromic catgut)
    - The "gray line" at the lash margin should first be repaired → then the anterior & posterior lid margins, using 5-0 or 6-0 monofilament
    - Orbiculans or levator muscles → repaired with absorbable sutures

  ![Image of Eyelid and Lacrimal System Injuries](David W. Kim, MD Facial Plastic and Reconstructive Surgery, UCSF)

  - **Nasal Injuries**
    - Restore near-perfect symmetry to avoid a cosmetically unfortunate result
    - Tissue loss → concern focuses on 3 major components: intranasal lining or mucosa, cartilaginous & bony framework & external cover or skin losses
    - Tissue loss < 5 mm in size → repaired primarily by mobilizing surrounding tissues & performing a layered closure

  ![Image of Nasal Injuries](David W. Kim, MD Facial Plastic and Reconstructive Surgery, UCSF)
Specific Types of Wounds

**Nasal Injuries**

- Complete amputations → microvascular replantation
- Avulsed segment < 1 cm → replaced & sutured back into position
- Losses of skin > 5 mm → local flaps or skin grafts
- Defects > 1.5 cm → tissue derived from forehead or nasolabial flap
- Composite defects → repaired with a combination of local flaps, cartilage grafts & skin/mucosal graft

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The Nose

- Septal Hematoma
  - Interrupts blood supply to septal cartilage
  - Will lead to cartilage resorption
  - Septal abscess
    - Sepsis, meningitis, death
  - Saddle nose

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Analysis

- Diagnosis depends on meticulous inspection and palpation.
- Fracture patterns
  - Lateral forces: ipsilateral bone → septum → contralateral bone
  - Frontal forces: dorsum → nasal bones → pyriform aperture → NOE
  - Younger patients with larger segments
  - Older patients with comminuted segments

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Nasal Fractures: Anatomy

- Paired nasal bones
- Ascending processes of maxilla
- Thicker cephalically
- Thinner caudally
- Articulates with frontal bone, nasal septum, upper lateral cartilages

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Analysis

- Length and orientation of osseous vault variable
- Assess through palpation.
- Assess in front of and above patient.
### Analysis

- Accurate assessment must be made after edema subsides
  - Duration of edema varies depending on severity of trauma, patient age, thickness of skin-soft tissue envelope, and post-injury management.
  - Few days to several weeks.

- Must obtain clear sense of patient’s expectation
  - Functional only?
  - Desires pre-morbid appearance?
  - Desires straight nose?
  - Desires other refinements?
  - Deviations of nasal dorsal line very noticeable due to typical lighting and linearity.

- Radiographs may not be clinically useful.
- May be required by insurance companies for reimbursement.
- Medico-legal
- Should obtain CT scan if concerned about NOE or other facial fractures.

### Fracture Classification

- **Unilateral:** moderate lateral forces
- **Bilateral:** higher energy lateral forces
Fracture Classification

- Open Book: moderate energy frontal force

- Comminuted or NOE: high energy force

Fracture Classification

- C-shaped, S-shaped: determined by dorsal septal deformities, typically from lateral forces

Management

- Conventional view of options for treatment:
  - Immediate closed reduction of simple fractures prior to onset of edema: within few hours
  - Closed reduction after swelling subsides, but prior to dense fibrous union: 5 days to 3 weeks.
  - Delayed definitive treatment after stable osseous union: after 6 months

Management

- Contemporary view of options for treatment:
  - Once edema resolves, can treat at any time
  - Approach (closed reduction vs. open reduction osteotomies via endonasal or external approach) determined by severity of injury, osseous stability, involvement of lower 2/3s, and patient’s aesthetic standards.

- Closed reduction

- Indications
  - Fracture segments sufficiently mobile (time until immobility is highly variable)
  - Main deformity is osseous
  - Mild to moderate deformity
Management

- Closed reduction
- Technique
  - Local, sedation, or general anesthetic.
  - Infiltration

Conclusions

- Prevention of unfavorable scars starts with good wound care and meticulous and thoughtful primary surgery
- Treatment strategy dependent on location and nature of injury

See page 18 for more detailed information.
<table>
<thead>
<tr>
<th>Pearls</th>
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<tbody>
<tr>
<td>6. Dermabond should be used in conjunction with deep layer closure</td>
</tr>
<tr>
<td>7. Secondary intention only for areas over solid convex surfaces</td>
</tr>
<tr>
<td>8. Key stitch at vermilion border</td>
</tr>
<tr>
<td>9. Drain auricular hematoma and pressure bolster</td>
</tr>
<tr>
<td>10. Always check for septal hematoma</td>
</tr>
<tr>
<td>11. Closed reduction nasal fracture—technique dependent on diagnosis</td>
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