

Advanced Suturing Skills for Complex Lacerations

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1

Disclosure

Ryan Strauss, Amy Keim, and James Marinucci have no financial interests or relationships to disclose.

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2

Learning Objectives

At the conclusion of this workshop, participants should be able to:

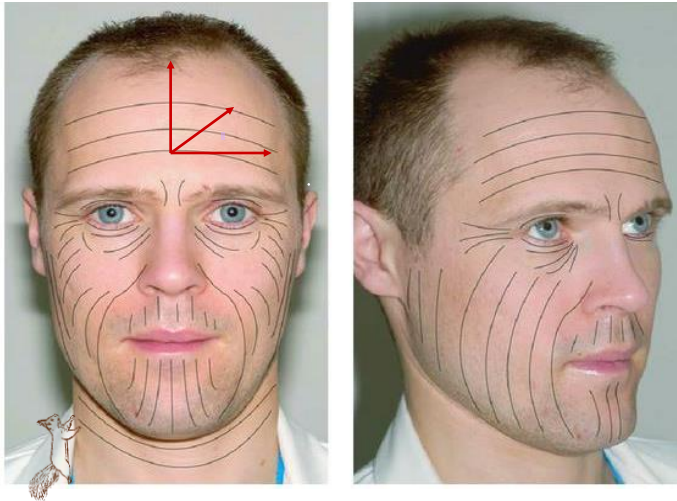
- Properly apply general and loose closure techniques.
- Perform multilayer cosmetic wound closure techniques
- Apply methods of accurate anatomic boarder alignment.
- Perform appropriate wound excision and debridement techniques.
- Perform management and repair of single and multiple flap lacerations.
- Perform management and repair complex parallel lacerations.
- Manage a variety of fingertip injuries including nail bed lacerations.
- Identify and prevent complications associated with complex nasal lacerations.
- Identify and prevent complications associated with complex ear lacerations.
- Review dog-ear deformity repair.

3

Facial Laceration Repair

4

Langer's Lines / Relaxed Skin Tension Lines



5

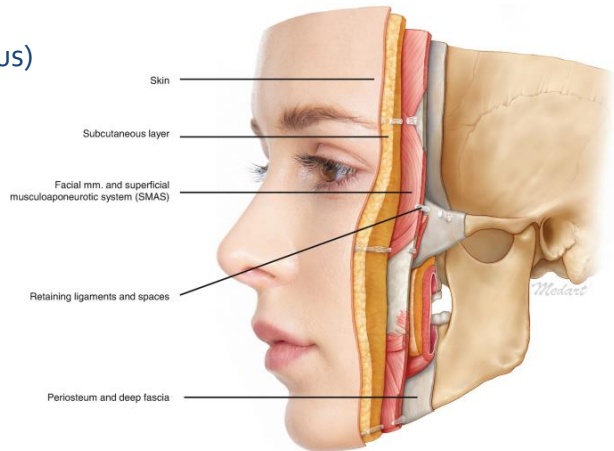
Effect of Skin Tension Lines on Healing



6

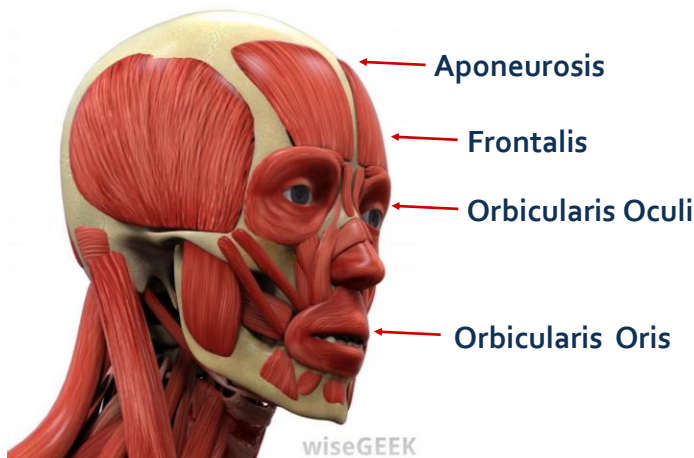
Facial Tissue Closure Layers

- ✓ Epidermis / Dermis (percutaneous)
- ✓ Dermis (intradermal)
- ✓ Muscle
- ✓ Galea
- ✓ Mucosa



7

Facial Muscles Requiring Closure



Any motor deficit must be addressed – differentiate nerve versus muscle injury and appropriate interventions

8

Skin Tension Lines & Multi-layered Closures



9

Special Considerations for Facial Wounds

Mechanism

Wound orientation

Layers of injury

Facial symmetry and anatomic alignment



10

General Facial Laceration Management

- ▶ Anesthesia
- ▶ Anatomical landmarks
- ▶ Layered closure
 - **Galea / aponeurosis:** monofilament synthetic absorbable 5-0 (4-0)
 - **Muscle:** braided or monofilament synthetic absorbable 5-0
 - **Intradermal:** braided or monofilament synthetic absorbable 5-0 or 6-0
 - **Percutaneous (PQ):** monofilament synthetic non-absorbable 6-0
- ▶ Check anatomical alignment and facial expressions post closure
 - Reposition light and check again

11

General Aftercare for Facial Wounds



Pressure dressing?

Daily wound care

Monitor for complications

Suture removal

Minimizing scars

12

General Pearls

- ✓ Poor placement of intradermal sutures can result in increased scarring
- ✓ Anesthesia can affect motor function on the face
- ✓ Feel for violation of aponeurosis / galea and for bony step-offs (depressed skull fractures)
- ✓ 6-0 Fast-absorbing plain gut or tissue adhesive can be used PQ in patients who are not expected to follow up for suture removal

13

Forehead Laceration with Devitalized Wound Edges



14

Special Considerations


- Crushed and devitalized tissue
- Selective debridement can improve wound outcomes
- Debridement increases skin tension
 - Avoid in areas that are > 45 degrees from Langer line
 - Incorporation of lines of tension when planning debridement
- Avoidance of complex structures that are not easily reconstructed (philtrum, eyelids, vermilion border...)
- Preserving anatomic border alignment
- Maintenance of facial symmetry post debridement

15

Management of Devitalized Tissue



*Never create a defect
to fix a defect!*

- ▶ Score tissue with #15 blade scalpel prior to cutting with iris scissors
- ▶ Keep edges perpendicular 
- ▶ Undermine as necessary to achieve a minimal tension closure
- ▶ Consider local anesthesia for additional hemostasis or to assist with tissue plane alignment
- ▶ Pressure dressing when appropriate

16

Debridement & Excision

Debridement / excision should be avoided in certain anatomic areas based on:

- Difficulty in reconstruction of the area
- The degree of attachment of the tissue to underlying tissues
- The degree of tension exerted on the skin normally at that location
- Lack of sufficient tissue

Areas not to excise :

- Philtrum, genitalia, pre-tibial area, palms and soles, areola, extensor surfaces, digits, nail bed, eyelid, tarsal plate

17

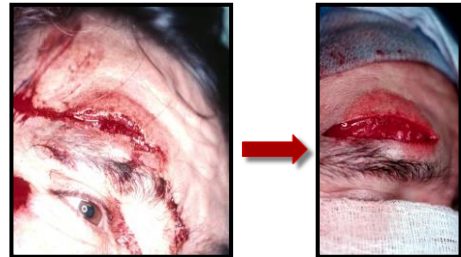
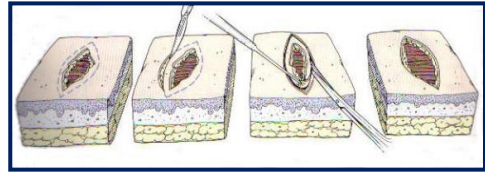
Laceration with Significant Soft Tissue Injury



18

Management Utilizing Wound Excision

- Work within 45 degrees of low-tension lines
- Consider anatomical landmarks
 1. Provide wide area of anesthesia
 2. Score in elliptical shape with #15 or #11 blade
 3. Excise tissue with iris scissors
 4. **Undermine** using blunt tissue dissection to release tension
 5. Apply pressure dressing



19

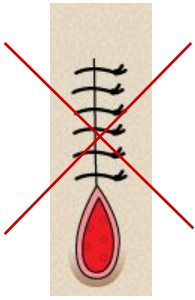
Wound Excision Pearls



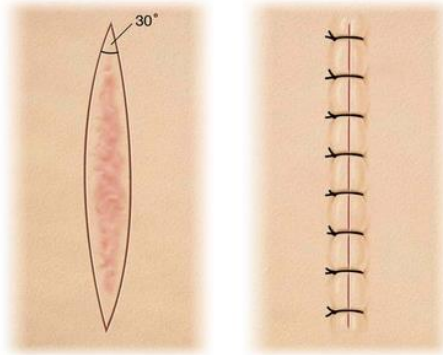
- ✓ Keep wound apices sharp
- ✓ Stay as close as possible to lines of the original wound
- ✓ Wider excisions require extension (lengthening) of wound to prevent "dog ears"
- ✓ Tight closure counterbalances increased tension
- ✓ Bleeding can be controlled with topical or injected epinephrine

20

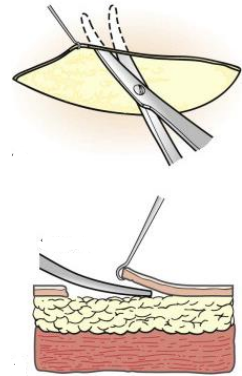
Excision Planning and Undermining



Dog Ear Deformity



Fusiform Elliptical Excision



Undermining

21

"Dog Ear" Deformity

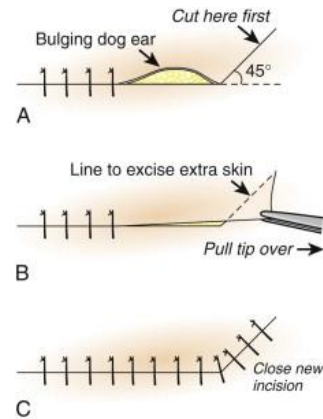


22

"Dog Ear" Revision

Potential mechanisms:

- ✓ Poor approximation
- ✓ "Divide and Conquer" technique
- ✓ Uneven loss of tissue
- ✓ Poor debridement technique
- ✓ Deliberate selective debridement



23

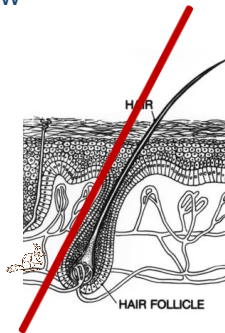
Anatomic Borders



24

Management of Eyebrow Lacerations

- ▶ Do not shave
- ▶ Align anatomic borders of eyebrow
- ▶ Allow avulsions to re-granulate in on own
- ▶ Limit debridement of eyebrow



25

Special Considerations for Anatomic Border Lacerations

Anatomical borders

- Lines of facial expressions
- Functional lines
- Wrinkles
- Hair lines
- Tattoos
- Vermillion border
- Nares / Helix



26

Management of Vermillion Border



1. Infraorbital or mental block (avoid local infiltration with epi)
2. Mark vermilion border
3. Avoid debridement of philtrum
4. Align vermilion border first with single holding suture or mark accordingly
 - Check alignment with alternating light source, at a distance, another set of eyes

27

Through and Through Lip Lacerations



28

Special Considerations for Through and Through Lip Lacerations



- ▶ Palate injury
- ▶ Dental involvement
- ▶ Maxilla / Mandible injury
- ▶ Anatomic landmark involvement
- ▶ Soft tissue foreign body

29

Management of Through and Through Lip Lacerations

- ▶ Infraorbital or mental block
- ▶ Mark vermilion border
- ▶ Limit debridement
- ▶ Irrigate with sterile water and provide suction
- ▶ Manage mucosal involvement

Recommended closure approach

- Irrigate from the inside out, then outside in → close muscle → intradermal → percutaneous → mucosa

30

Management of Through and Through Lip Lacerations

- ▶ Repair mucosa with chromium gut / plain gut
 - Buried knot percutaneous suture
- ▶ Prophylactic antibiotics
 - Penicillin (clindamycin for PCN allergy) x 5 days
- ▶ Commissure
 - Consider plastic surgery management of commissure lacerations

31

Tongue Lacerations



32

Special Considerations for Tongue Lacerations

Characteristics of tongue lacerations requiring primary repair in the ER:

- ▶ Larger than 1cm
- ▶ Bisecting wounds
- ▶ Flaps
- ▶ Persistent bleeding
- ▶ Gaping at rest
- ▶ U-shaped



33

Management of Tongue Lacerations

- Inferior alveolar block for anterior 2/3rds of tongue
- Grasp tongue with gauze or retract with suture through tip secured to chest
- Repair through and through muscle with Vicryl or PDS prior to mucosal surface
- Repair mucosa with a Chromic or Plain Gut buried knot
- Adjust tension to allow for post repair edema
- Soft diet and rinse mouth after eating
- No antibiotics indicated
- Edema management / precautions

34

Nasal Lacerations / Cartilage Injury



35

Considerations for Nasal Lacerations

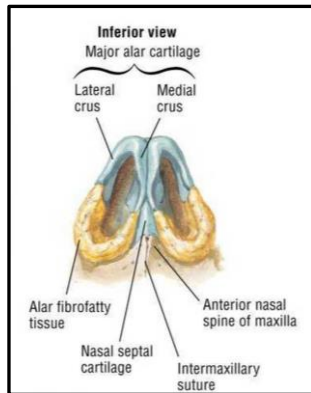
Carefully evaluate for occult:

- ✓ Involvement of anatomic border of nares
- ✓ Involvement of columella
- ✓ Lacerated or fractured cartilage
- ✓ Septal defects/ septal hematomas
- ✓ Open bone fracture



36

Cartilage Lacerations



Cartilage is avascular...

- Metabolic support provided by surrounding perichondrium
- Increased risk of:
- Infection
- Erosive chondritis and subsequent necrosis

37

Management Columella and Nostril Lacerations

- ▶ Anesthesia with topical or local infiltration using TB syringe
- ▶ Conservatively debride any obvious devitalized cartilage
- ▶ Use nasal speculum and head lamp
- ▶ Align anatomic borders with 'holding stitch'
- ▶ Irrigate open fracture/ cartilage copiously

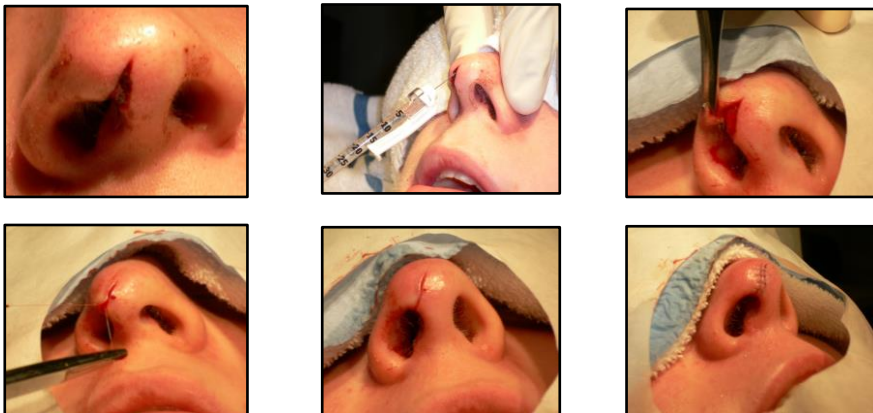
38

Management Columella and Nostril Lacerations

- Drain septal hematomas and pack nares after repair
- Cartilage fractures can be re-approximated/ splinted using
- Antibiotics for open fracture to bone or cartilage or nasal packing
- Wound follow up in 48hrs

39

Nares Repair



40

Helix Laceration



41

Special Considerations for Ear Lacerations

- ▶ Human bites
- ▶ Anatomic structure function
- ▶ Associated injuries
- ▶ Evaluate cartilage
- ▶ Auricular hematomas



42

Management of Helix Lacerations

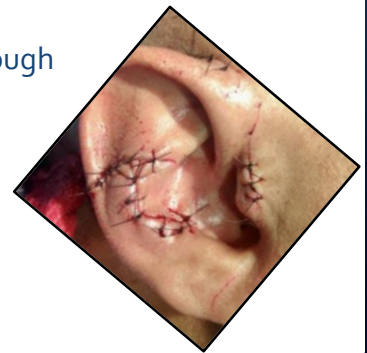
- ▶ Auricular field block vs. local anesthesia
- ▶ Conservatively debride obvious devitalized cartilage
- ▶ Align anatomic borders



43

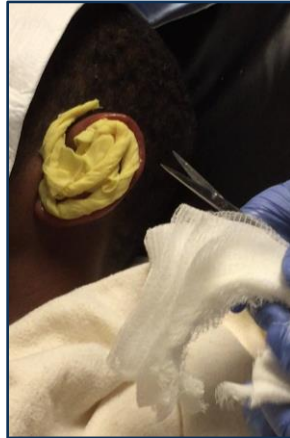
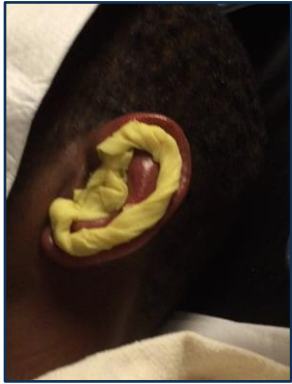
Management of Helix Lacerations

- ✓ Cartilage fractures can be re-approximated / splinted, if necessary, using synthetic braided 6-0 through perichondrium
 - Suture both sides of perichondrium if through and through
- ✓ Pressure dressing x 72 hours
- ✓ Prophylactic antibiotics x 5 days if cartilage involved
- ✓ Close follow-up to re-evaluate for hematoma / infection



44

Compression Dressing



45

Earlobe Laceration



46

Special Considerations for Ear Lobe Tears

- ▶ Integrity of healed tissue is less than non-traumatized tissue
- ▶ Contractile forces of healing may result in notch deformity



47

Management of Earlobe Laceration

1. Auricular Field Block
2. Local infiltration into the ear lobe (no epi) for additional anesthesia and tissue distension
3. Stabilize ear lobe posteriorly w/ sterile tongue blade and 27g needles
4. Use skin marker to mark excision sites
5. Score ear lobe for "wedge & cube" excision
6. Excise wedge and cube using straight iris scissors



48

Earlobe Laceration Repair

- ▶ Place intradermal sutures after excision
- ▶ Align anatomic borders
- ▶ Consider half-buried mattress stitch (flap stitch) to stabilize corners, if possible
- ▶ Pressure dressing?

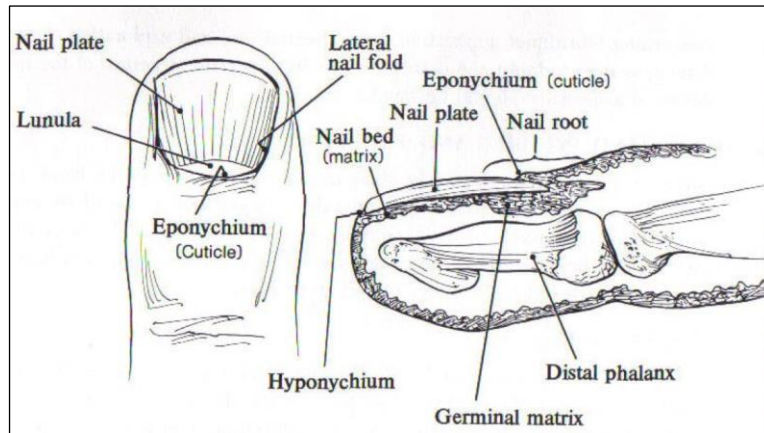


49

Fingertip Injuries

50

Fingertip Anatomy



51

Distal Tip Avulsion



- ▶ Avulsion v. Amputation
- ▶ Hemostasis
- ▶ Significant loss of volar tissue may require graft
- ▶ Antibiotics?
- ▶ Generally, the distal tip granulates well if avulsion is less than 1-2cm² and no bone is involved

52

Fingertip Avulsion Management



- ▶ +/- digit block
- ▶ Clean with soap and irrigate with tap water
- ▶ Elevate above level of heart
- ▶ Cut Gelfoam or Surgicel dressing to slightly larger than avulsion
- ▶ Cover with bacitracin, Xeroform, or Adaptic gauze and gauze wrap
- ▶ Keep in place x 48hrs, thereafter wash and pat dry and apply bacitracin over Gelfoam and bulky gauze dressing twice a day
- ▶ Gelfoam / Surgicel typically fall off on own once sufficient epithelialization occurs
- ▶ In order to remove prior to falling off, soak in warm water until soft and gently remove

53

Fingertip Crush Injuries



- ▶ Potential fracture / Open fracture
- ▶ Subungual Hematoma
- ▶ Nail bed laceration
- ▶ Tendon rupture
- ▶ Edema

54

Subungual Hematoma Management

- ▶ Management is still controversial
 - > 50%
 - Stable v. Unstable nail plate
 - Remove nail plate and repair nail bed
 - < 50%
 - Trephinate
 - The trephinated hole(s) should be large enough to drain all the subungual hematoma
- *Address potential open fracture*



55

Nail Plate Trephination



56

Nail Avulsion



Proximal nail plate avulsion without nail bed injury

- Horizontal mattress suture

Distal nail avulsion

- If still adhered to matrix trim back unstable nail portion only

Unstable partial nail plate avulsion

- Debride entire nail plate if unstable



57

Nail Plate Removal



58

Nail Bed Repair



** Future nail growth is dependent on accuracy of repair*

Potential adverse outcomes:

- ▶ Ridged nails
- ▶ Nail re-growth curved down towards distal tuft
- ▶ Nail re-growth split along scar line
- ▶ Unstable nail plate

59

Nail Bed Laceration Management

- ▶ Stabilize fingertip first
- ▶ Take care not to suture skin to germinal matrix at proximal nail
- ▶ Use synthetic absorbable suture to carefully re-approximate nail bed using buried knot percutaneous stitch
- ▶ If a significant portion of nail bed or germinal matrix is avulsed (missing) refer to hand surgery
- ▶ Consider Dermabond *

Strauss, EJ, Weil, WM, Jordon, z et al; A prospective, randomized, controlled trial of 2-octylcyanoacrylate versus suture repair for nail bed injuries



60

Post Repair

- ▶ Controversy on splinting proximal nail fold
- ▶ Apply emollient nail bed dressing
- ▶ Fractures should be splinted with short distal allumifoam
- ▶ Antibiotics ?
- ▶ 48hr wound check for open fractures



61

Nail Bed Dressing



62

Flap Lacerations

63

Proximal (Antegrade) Flap Lacerations



Base of the flap is **proximal** to 

64

Distal (Retrograde) Flap Laceration



Base of the flap is **distal** to 

65

Flap Laceration Concerns

The problem with flaps.....

- *Arterial circulation re-establishes within 6-8 hours*
- *Venous drainage re-establishes 12-48 hours after repair*
- *Lag between the two → venous engorgement → decreased arterial flow → tissue hypoxia*

66

Additional Flap Laceration Concerns



- ▶ Survival of flap tissue is dependent on perfusion pressure and venous drainage
- ▶ When intravascular perfusion pressure < interstitial pressure (increases with edema and inflammation) → capillary collapse
- ▶ Perfusion pressure decreases from the base of the flap to the apex
- ▶ Flaps with length > 3 times the length of the pedicle → higher risk of distal necrosis

67

Improving Flap Viability

Management options

- *Loose closure along low-tension aspect*
- *Drain*
- *Compression*
- *Reducing length flap*
 - *V→Y debridement procedure*
- *Flap excision*
 - *Create elliptical excision incorporating flap*
- *Selective debridement of apex*
- *Reducing volume of suture through flap apex*

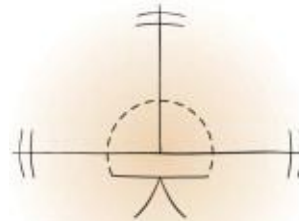
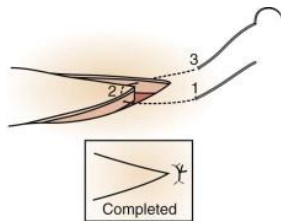
68

Stellate Lacerations



69

Half-Buried Mattress



- Avoid tying suture over apex
- Debride tip of apex if flap is not viable
- If multi-flap --> tie across last edge of laceration to prevent dimpling

70

Parallel Lacerations

71

Parallel Laceration



72

Approaches to Parallel Lacerations

- ▶ Excise skin bridges that are too thin / devitalized
 - Convert skin bridge to ellipse and excise to create single linear wound
 - Debride and treat like a burn
- ▶ Run horizontal mattress across skin bridges
- ▶ Commonly will have to implement multiple techniques

