Objectives

- At the conclusion of this workshop, the student will be able to:
  - Describe the phases of wound healing and patient factors associated with poor wound healing
  - Discuss appropriate use of local anesthesia, and when to refer wounds for surgical evaluation
  - Discuss the initial steps in wound care, including cleaning and debridement, tissue handling, and wound closure
  - Identify elements needed for coding and reimbursement
  - Discuss the role of antibiotics
  - Identify the appropriate time frame for follow-up and suture removal
Phases of wound healing

- Hemostatic phase
  - Within minutes post-injury, platelets aggregate at the injury site to form a fibrin clot

- Inflammatory phase
  - Bacteria and debris are phagocytosed and removed, and factors are released that cause the migration and division of cells involved in the proliferative phase

- Proliferative phase
  - Angiogenesis, collagen deposition, granulation tissue formation, epithelialization, and wound contraction

- Remodeling phase
  - Collagen is remodeled and realigned along tension lines and cells that are no longer needed are removed by apoptosis

Patient factors that affect wound healing

- Blood supply to the wound
- Tissue quality
  - Baseline
  - Post-injury
- Nutritional status
- Comorbidities
  - Smoking/nicotine use
  - Diabetes
  - Vascular insufficiency
  - Obesity
  - Immunodeficiency/chemotherapy/radiation therapy

Wound healing

- Wounds heal bottom-to-top
  - Epithelial tissue grows side-to-side
    - Edges of wound are everted to promote epithelialization
Approaches to Wound Closure

- Primary intention
  - Clean incision
  - Early suture
  - Healing scar
- Secondary intention
  - Delayed wound healing
  - Healing by contraction
- Healing by secondary intention
  - Granulation tissue fills in wound
  - Large scar

Wound Complications

- Wound infection
- Wound dehiscence

Approach to the fresh, uncomplicated wound

- Consent to treat/procedural consent
- Tetanus prophylaxis
- Anesthesia
- Hemostasis
- Cleaning and debridement
- Wound closure
Consent and pre-procedural pause

- Must be informed consent
- Document in PARQA format
  - Procedure
  - Alternatives
  - Risks
  - Questions
  - Answers

- "Time Out" or "Pre-procedure pause"
  - Everyone stops and listens—Including patient if possible
  - Correct patient—Correct provider—Correct procedure—Correct side/location

Anesthesia

- Verify Allergies
- Common local anesthetic options
  - Xylocaine© (lidocaine)
  - Marcaine© (bupivacaine)

<table>
<thead>
<tr>
<th>Local anesthetics for Wound Care</th>
<th>Concentration</th>
<th>Indication</th>
<th>Duration of block</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lidocaine 1%</td>
<td>60 kg adult = 300 mg = 30 mL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lidocaine 1%</td>
<td>Immediate</td>
<td>30-60 min</td>
<td></td>
</tr>
<tr>
<td>Lidocaine 2%</td>
<td>Immediate</td>
<td>60-120 min</td>
<td></td>
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<tr>
<td>Bupivacaine 0.34% 0.5%</td>
<td>Shorter</td>
<td>24-480 min</td>
<td></td>
</tr>
<tr>
<td>Xylocaine</td>
<td>Depending</td>
<td>5-15 min</td>
<td>20-30 min</td>
</tr>
</tbody>
</table>

- Do not use epinephrine on eyes, nose, penis, nipples, and toes
- KNOW YOUR MAXIMUM DOSE before you inject!!!
  - Lidocaine = 5 mg/kg
  - (Lidocaine 1% in 60 kg adult = 300 mg = 30 mL)
  - Lidocaine with epinephrine = 7 mg/kg
  - Bupivacaine = 2 mg/kg
  - Bupivacaine with epinephrine = 3 mg/kg

- If the wound is large, consider regional block or referral to surgery for more anesthesia/analgesia options
- Conscious sedation with Propofol or Ketamine

Local anesthesia precautions
**Hemostasis**

- Direct pressure
- Electrocautery
- Chemical cautery
  - Silver nitrate
  - Chitosan/Zeolite (QuikClot©)
- Suture ligation
  - Use figure-of-eight/simple cruciate stitch

**Cleaning and debridement**

- Repairing lacerations is a CLEAN procedure—not STERILE
- Mechanical cleansing is by far the most important!
  - **COPIOUS** amounts of saline/LR/water
  - Scrub wound (gauze, scrub brush, etc.)
  - “Wound cleanser” (e.g. J&J Baby Shampoo, Hibiclens)
  - Explore the wound to make certain you have not missed an undermined flap!
- Minimal evidence for chlorhexidine or antibiotic solutions
- No evidence for iodine/betadine, hydrogen peroxide, or alcohol

**Debriding wounds**

1. Remove foreign bodies
2. Remove devitalized tissue
   - If there is concern for how the wound will close, consult surgery
   - If there is concern for tissue viability, consult surgery
   - If there is concern that a wound extends into a joint space, consult orthopedics
3. Keep the wound moist
4. Visualize how the wound will close—can you adjust the wound for cosmesis and/or to avoid “dog ears”?®
**Tools of the trade**

- Measuring device
- Syringe(s) with needles (18g & 25g)
- Splash shield (for irrigation)
- Toothed forceps
- Scalpel
- Needle holder
- Scissors
  - For cutting suture—not tissue!
- Clamp(s)
  - For BLUNT dissection—not “clamping”!
Wound Closure

- **Staples**
  - Quick, easy, evert edges well, easy to remove
  - Can use on arms, legs, abdomen, back, or scalp
  - Wounds on the hands, feet, neck, or face should not be stapled
  - More difficult to correctly align wound edges, generally cost more than sutures
  - Larger scars/less desirable cosmetic result, uncomfortable
- **Adhesives**
  - Quick, easy
  - Only small wounds, high infection risk
- **Sutures**
  - Best cosmetic result in skilled hands, single provider
  - Best used in wounds with need for deeper layers
  - Time consuming

Suture choice - size

- 3 to 12-0
- Numbers alone indicate progressively larger sutures, whereas numbers followed by O indicate progressively smaller sutures
- Use smallest size for strength needed

Suture choice - Filament

- **Mono filament**
  - Single fiber
  - Less inflammatory response
  - Lower infection risk
  - Difficult to work with/knots more likely to come undone
- **Braided filament**
  - Multiple fibers
  - Easier to work with
  - Knots more likely to stay/fewer throws
Suture choice – Organic vs Synthetic

Organic
• Cheap
• Readily Available

Synthetic
• Lower inflammatory response
• More expensive

Suture choice – Absorbable?

• Absorbable – no need to remove
  • Good for places where suture hard to retrieve
  • Good for patients at risk for loss to follow-up
  • Not permanent (not for repairing vessels or fluid-filled structures)
  • Tensile strength during later phases unpredictable

• Natural
  • Fast gut
  • Chromic gut

• Synthetic
  • Vicryl® (Polyglycolic Acid)
  • Monocryl® (Poliglecaprone)
  • PDS® (Polylactide)

Suture choice – Needles

• The most common body configuration in dermatological surgery is curved, with a radius of between 1/4 and 5/8 of a circle.

• Needle tip
  • Conventional cutting (sharp edge on the inside arc)
  • Reverse cutting (sharp edge on the outside arc)
  • Tapered tip – least likely to cause tissue tearing.
Simple Interrupted
• Basic appositional pattern
• Easy to perform
• Best for wound not under tension
• Optimal wound healing
• Minimal scar formation
• Simple Running
  • Basic appositional pattern
  • Best for wound not under tension
  • Optimal wound healing
  • Minimal scar formation
  • Easily removed
  • Higher chance for dehiscence

• Deep/Subcuticular Interrupted
  • Basic appositional pattern
  • Best for wound not under tension
  • Used for reconnecting deeper structures
  • Used for minimizing dead space within wounds
  • Usually absorbable suture

• Intradermal / Subcuticular Running
  • Appositional pattern
  • Best for wound not under tension
  • Optimal cosmetic result with minimal scar formation
  • Use absorbable suture
  • Do NOT use dyed suture!
• Locked running
  • Basic appositional pattern
  • Best for wound not under tension
  • Minimal scar formation
  • Easily removed
  • Less chance for dehiscence, though higher than interrupted

• Vertical Mattress
  • Tension-relieving pattern
  • Produces well everted edges
  • Allows for maximal tension relief

• Horizontal Mattress
  • Tension-relieving pattern
  • Produces well everted edges
  • Allows for maximal tension relief
  • Slightly more chance of wound dehiscence
  • Can cause decrease in blood supply to wound edges

• Figure-of-eight / Interrupted cruciate
  • Basic appositional pattern
  • Stronger closure than simple interrupted
  • Best for wounds not under tension
  • Used for ligation of vessels
• Far-far-near-near / Far-near-near-far
  • Maximal tension relief
  • May cause eversion and resultant scar formation

• Mayo mattress (vest-over-pants)
  • Overlaps one tissue edge over another
  • Usually only used in fascial repair/herniorrhaphy

• Purse-string
  • Usually for closure around structures (e.g.: chest tubes, ostomy tubes, etc)
  • May be used as a deep suture to draw dog-ears and stellate wounds closer together

• V-shaped wounds
  • Goal is to avoid suturing the point of a v-shaped flap
    • The point is quite likely to become necrotic
    • We would like to preserve as much tissue as possible
    • We don't want to depend on necrosing tissue for strength to keep closed
  • Looped suture near apex is optional, and not recommended if the flap is thin
• Wound closure over a drain
  • When there is a high suspicion for a wound to develop a localized fluid collection and/or abscess (e.g. when a large area of dead space remains after wound closure)
  • May increase infection rate when used prophylactically
  • May be simple passive drains (e.g. Penrose), simple closed vacuum drains (e.g. Jackson-Pratt drain, tubular drains with bulb suction), or complex vacuum closure device (e.g. Wound VAC ©)

Documentation

• Consent
• Number of lacerations
• Size (length x width x depth)
• Location
• Debridement
  • Foreign body removal
  • Instrument used
  • Size of margins excised / area of excision

Documentation

• Type of wound closure
  • Simple
    • Single layered closure without significant debridement
  • Intermediate
    • Some deep layers, or single layer with some debridement
  • Complex
    • Extensive debridement or undermining
    • Reconstructive
    • Adjacent tissue transfer or rearrangement
• Materials used
  • Include number of stitches, type of suture, size, etc.
Documentation – Procedure Details:

• "After obtaining informed consent/PARQ, a procedural pause was performed. The laceration(s) was/were identified. The area was anesthetized with ____. After ensuring appropriate anesthesia, the wound was cleansed and irrigated with ____. The wound was inspected and found to be (full/partial thickness) with/without exposed (bone/tendon/etc.) ____. Hemostasis was achieved with _____. No debridement was indicated. Wound size: ____ x ____ x ___. The wound edges were then approximated with (#) simple interrupted (size) (material) sutures. The patient was monitored throughout the procedure and tolerated the procedure well. Closure was complete with good hemostasis. ____ dressing was placed."

Antibiotics?

• Dirty wounds don’t necessarily need antibiotics!
• Any sign of infection = open the closure and explore
  • Antibiotics only when evidence of surrounding infection (e.g. cellulitis)
• When indicated, cover for common pathogens
  • Always consider MRSA

Suture Removal

• Remove as soon as the wound has healed enough to withstand the expected stress or pressure on that area
  • If stitches are left in place beyond that period, they will most likely leave an unwanted scar.
• Approximate guidelines are as follows:
  • Face: 3 to 5 days
  • Scalp: 7 to 10 days
  • Neck: 5 to 7 days
  • Extremities: 10 to 14 days/14 to 28 days under tension (joints)
  • Back: 10 to 14 days
  • Abdomen: 7 to 10 days