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
  - Immune deficiency/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

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

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>Induration</th>
<th>Duration of Block</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lidocaine 5% 2%</td>
<td>Immediate</td>
<td>30-60 min</td>
<td></td>
</tr>
<tr>
<td>Lidocaine 0.5% 1%</td>
<td>Immediate</td>
<td>30-120 min</td>
<td></td>
</tr>
<tr>
<td>Marcaine 0.25% 0.5%</td>
<td>Slow</td>
<td>20-240 min</td>
<td></td>
</tr>
<tr>
<td>Tetracaine 2.5%</td>
<td>Depending</td>
<td>5-10 min</td>
<td></td>
</tr>
</tbody>
</table>

- do not use epinephrine on ears, nose, penis, fingers, and toes!

Local anesthesia precautions

- Do not use epinephrine on fingers, toes, penis, ears, eyes
- 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
Releasing 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”? 
Tissue Handling

- **CUT**, don't crush!

Tools of the trade

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

• Staples
  • Quick, easy, even 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

Su·ure 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

Su·ure 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

Numbers alone indicate progressively larger sutures, whereas numbers followed by O indicate progressively smaller sutures.
Su·re choice – Organic vs Synthetic

<table>
<thead>
<tr>
<th>Organic</th>
<th>Synthetic</th>
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<tbody>
<tr>
<td>• Cheap</td>
<td>• Lower inflammatory response</td>
</tr>
<tr>
<td>• Readily Available</td>
<td>• More expensive</td>
</tr>
</tbody>
</table>

Su·re 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 © (Polydioxanone)

Su·re 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.
10/13/2015

• Simple Interrupted
  - Basic appositional pattern
  - Easy to perform
  - Best for wound not under tension
  - Optimal wound healing
  - Minimal scar formation

Knots

- Square
- Slip
• 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
    • Looping 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

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.
**Documentati - 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: __ L x __ W x __ D. The wound edges were then approximated with (th) 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