Basic & Advanced Wound Closure Techniques

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Wound Management - General Principles

Phases of Wound Healing

Phase 1 - Coagulation & Inflammation
Days 1 to 5
Tensile strength of wound ~5% of normal skin

Phase 2 - Proliferation
Days 5 to 14

Phase 3 - Remodeling
Day 14 to complete healing
Tensile strength 15-20% at 3 weeks & 60% at 4 months
Continues to increase up to 1 year (70-90% of original)
**Anesthesia**

- **Lidocaine**
  - Max dose 5-7mg/kg
  - Duration ~60 mins

- **Epinephrine**
  - Prolongs duration, promotes hemostasis and reduces systemic absorption
  - Avoid with Fingers, Nose, Penis, Toes (and Ears)
  - Increases incidence of infection
    - Avoid with contaminated wounds

**Topical**

- LET gel - lidocaine/epinephrine/tetracaine
  - Avoid with end artery and contaminated wounds
Local vs. regional
- Less distortion w regional
- Transthecal (palmar) digital nerve block
  - Uses the flexor tendon sheath for infusion of anesthesia
  - A single injection of 2-3 mL of 1 or 2% epi-free lidocaine through the flexor tendons at the base of the digit
  - Inadequate for thumb and the dorsal aspect of the third digit's proximal phalanx b/c of incomplete anesthesia
- Skin & Wound Preparation
  - Skin Cleansing
  - Hair Removal
    - Eyebrows should never be shaved
    - Plaster hair down if possible
  - Wound Irrigation
    - Removes contaminants, reduces infection, improves visualization
  - Wound Debridement
  - Wound Excision
  - Wound Undermining
    - Approximately double the width of the gap
    - Do not undermine contaminated tissue
    - Never on palms, soles or face
Simple Suture

Close Dead Space
Loosely Approximated Alignment
Equal Depth
Slight Eversion
Running Sutures

- Rapid
  - Holds in two planes
  - Not with contaminated wounds
Running Locked

Great for scalp lacerations b/c of good hemostasis
Vertical Mattress

Ensure wound eversion

Higher risk of local ischemia
Horizontal Mattress

Ensure wound evasion
Higher risk of local ischemia
Half-buried Mattress (Apex)

Used for tips and margins of flaps

Greater risk of mismatch of height & length
Sub-cutilcular

Skin suture marks avoided
Difficult to achieve accurate edge approximation
- **Time of Injury**
  - Few studies to determine max time to closure
  - Bacteria count increases dramatically >3-6hrs
  - **Face & Scalp** - 12 to 24 hours (>48hrs)
  - **Other areas** - 6 to 12 hours
    - Not heavily contaminated
    - Not in high-risk area (hand or foot)
### Characteristics of Tetanus-Prone Wounds

<table>
<thead>
<tr>
<th>Clinical Feature</th>
<th>Tetanus-Prone</th>
<th>Non-tetanus-prone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contaminants</td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>Devitalized tissue</td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>Infection</td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>Ischemic</td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>Mechanism</td>
<td>Burn, crush, bullet</td>
<td>Sharp &amp; smooth</td>
</tr>
<tr>
<td>Wound age</td>
<td>&gt; 6 hours</td>
<td>&lt;6 hours</td>
</tr>
<tr>
<td>Wound depth</td>
<td>&gt; 1 cm</td>
<td>&lt; 1 cm</td>
</tr>
<tr>
<td>Wound type</td>
<td>Abrasion, avulsion, crush, irregular, stellate</td>
<td>Linear or straight</td>
</tr>
</tbody>
</table>
# Tetanus Prophylaxis

<table>
<thead>
<tr>
<th>Immunization Hx</th>
<th>Tetanus-prone</th>
<th>Non-tetanus-prone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hx of adsorbed Td</td>
<td>Td &amp; TIG</td>
<td>Td &amp; TIG</td>
</tr>
<tr>
<td>Unknown or &lt;3 doses</td>
<td>Td, TIG &amp; complete series</td>
<td>Td &amp; complete series</td>
</tr>
<tr>
<td>Fully Immunized, &gt;5y &amp; &lt;10y</td>
<td>Td</td>
<td>None needed</td>
</tr>
<tr>
<td>Fully Immunized, &lt;5 years</td>
<td>None needed</td>
<td>None needed</td>
</tr>
<tr>
<td>Fully Immunized, &gt;10 years</td>
<td>Td &amp; TIG</td>
<td>Td</td>
</tr>
</tbody>
</table>

Td, tetanus and diphtheria toxoids; TIG, tetanus immune globin.
Discharge Instructions

- High risk wounds should be reevaluated in 24hr
  - Bites, hand wounds, heavily contaminated and wounds requiring prophylactic Abx
- One in ten persons develops a wound infection
- RTC if signs of infection develop
  - Wound becomes red or has discharge, streaks develop or patient develops a fever
## Suture Removal

<table>
<thead>
<tr>
<th>Location</th>
<th>Days</th>
<th>Location</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face</td>
<td>3-5</td>
<td>Neck</td>
<td>3-4</td>
</tr>
<tr>
<td>Arm</td>
<td>7-10</td>
<td>Hand</td>
<td>10-14</td>
</tr>
<tr>
<td>Chest</td>
<td>7-10</td>
<td>Back</td>
<td>10-14</td>
</tr>
<tr>
<td>Buttocks</td>
<td>10-14</td>
<td>Legs</td>
<td>8-10</td>
</tr>
<tr>
<td>Foot</td>
<td>10-14</td>
<td>Joints</td>
<td>10-14</td>
</tr>
</tbody>
</table>

Depends on location, amount of tension and healing time of tissue
Scar Formation

6 to 12 months required to form a mature scar
Adequate immobilization is essential
Of wound not entire anatomic part

Hypertrophic Scar
Thick and raised scar within original boundaries

Keloid
Exceeds the boundaries of initial injury
References

- Emergency Management of Skin and Soft Tissue Wounds.
  Ernest N Kaplan MD
  Vincent R Hentz MD