Wound Closure for the ER / Urgent Care & Pitfalls in Wound Closure and Optimal Materials & Repair Techniques

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Disclosure Statement
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- ETHICON Inc. – employer
  - National clinical consultant
  - Physician Education

- Only standard products and generalities will be spoken to during this presentation. Suture and TSA information is for educational purposes only.

Goals

- Review methods of wound evaluation and management that will optimize outcomes
- Discuss the various materials and techniques used in wound management
- Identify high risk wounds
- Identify methods to reduce morbidity associated with high risk wounds
- Simplifying Closures
- Treat them and Street them

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Wound Care is the second most common source of malpractice litigation, accounting for up to 20% of claims.

 `<image>`

Wound Care - Why You Should Care!

Common Wound Complications

- The most common causes of litigation resulting from wound care are:
  - retained foreign bodies
  - missed tendon, nerve or joint injury
  - wound infection

Finger and Hand Injuries

- Tendon and Nerve Injuries
- Foreign Bodies
- Puncture Wounds
- Mammalian Bites

Be Aware! High Risk Injuries
Lacerations in ER/ Urgent Care
- Annual Visits in US greater than 120 million
- Estimated number of lacerations > 12 million

Days Away from Work
In 1994, lacerations to the fingers ranked third after back and leg strains in frequency.

| Risk | Body part | Number Base | Number Incl. | Days off
| 1    | Finger    | 52,077     | 101.1        | 101.1
| 2    | Back      | 22,249     | 59.4         | 59.4
| 3    | Finger    | 22,481     | 59.9         | 59.9
| 4    | Finger    | 11,735     | 25.5         | 25.5
| 5    | Finger    | 11,735     | 25.5         | 25.5
| 6    | Hand      | 15,671     | 46.1         | 46.1
| 7    | Head      | 12,006     | 36.2         | 36.2
| 8    | Arm       | 13,796     | 1.3          | 1.3
| 9    | Finger    | 12,658     | 1.4          | 1.4
| 10   | Finger    | 12,658     | 1.4          | 1.4
| Total |           | 222,761    |              | 222,761

- Developed from: Courney and Webster (1990), Table 4.
- Numbers refer to number of injuries per 10,000 full-time workers per year (1990).

Finger and Hand Injuries – Subtle
- May cause significant morbidity, missed time off work, and stress
- Only a few millimeters separate a superficial laceration from a significant deep structure injury!
Primary Goals of Wound Closure

- Stop Bleeding
- Preserve Function
- Restore Cosmetic Appearance
- Prevent Infection

What Do Patients Want?

<table>
<thead>
<tr>
<th>Aspect of Care</th>
<th>All Participants (n = 679)</th>
<th>Partial Revisions in 75%</th>
<th>Other Revisions in &gt;95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Function</td>
<td>20%</td>
<td>27%</td>
<td>34%</td>
</tr>
<tr>
<td>Acute Infection</td>
<td>20%</td>
<td>14%</td>
<td>23%</td>
</tr>
<tr>
<td>Cosmetic Outcome</td>
<td>15%</td>
<td>35%</td>
<td>16%</td>
</tr>
<tr>
<td>Lead pain</td>
<td>17%</td>
<td>11%</td>
<td>18%</td>
</tr>
<tr>
<td>Length of stay</td>
<td>10%</td>
<td>8%</td>
<td>10%</td>
</tr>
<tr>
<td>Complication</td>
<td>5%</td>
<td>4%</td>
<td>5%</td>
</tr>
<tr>
<td>Cost</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Days missed</td>
<td>2%</td>
<td>1%</td>
<td>3%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Additional Goals of Wound Care

- Minimize Pain and Discomfort
- Maximize Patient Satisfaction
- Fast Delivery of Care
- Simplify Care
- Reduce Need for Follow Up
- Minimize time off from work
Wound Evaluation – History

- Mechanism
- Time
- Foreign Body?
- Medical Conditions
- Allergies – latex, anesthetics, antibiotics?
- Tetanus Status

Mechanism – What is the Risk?

- Shear Injury: wound from a sharp instrument; increased risk of tendon, nerve or vascular injury
- Compressive Injury: hard object vs bony prominence
  - stellate laceration
  - significant tissue injury
  - 100 fold increased risk of infection
  - Blood accumulation is a biggest risk factor
- Bites and Punctures – risk of infection
- Foreign Body? Always assume one is present!
- Paint gun injury – emergency!

Time

- Time interval from injury to closure with low infection rate
- Dependent on patient and wound factors:
  - Location
  - Etiology
  - Timing
  - Comorbidities

Healing Rates

**Time – Primary Closure Guidelines**

- Current American College of Emergency Physicians policy is no more than 8 to 12 hours from the time of injury.
- Wounds that are at low risk for infection, safely approximated up to 12 hours after the time of injury.
- Likewise, wounds that are at moderate risk or infection within a 6- to 10-hour period.
- High risk wounds – within 6 hours or delayed closure.
- Clinical judgment may allow the time period for primary repair in certain situations to be extended up to 24 hours.


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**Pitfalls of Physical exam**

- Missing injury to a deep structure:
  - tendon
  - nerve
  - vascular injury
  - bone or joint injury
- Not detecting a foreign body
- Not detecting devitalized tissue
- LIKELY YOUR HIGHEST RISK OF LITIGATION!!

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**Importance of Hemostasis**

- Wound exam in a bloodless field reduces risk of overlooking a deep tissue injury or foreign body
  - critical in reducing wound related litigation!
  - especially when exploring hand/digit wounds
  - "exam not complete until bleeding controlled, wound cleansed and explored to its depth."
- Reduces risk of blood exposure while performing exam and repair
- Use physical pressure
- Use Hemostasis products

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Failure to identify FB increases risk of:
- inflammation  - infection
- delayed healing  - loss of function

In a retrospective study of patients with hand wounds, 38% had FB missed by physician on initial wound inspection (EM Clinics NA 2007)

High risk wounds: punctures, head or foot, MVA, stepping on glass, or pt can "feel" FB
Skin and Wound Preparation

- Hair removal – don’t*
- Soaking – don’t
- Disinfecting the Skin – gently scrub, don’t use: Hibiclens, Betadine or full strength hydrogen peroxide
- Wound Cleansing and Irrigation – yes!
- Debridement – important!

Wound Cleansing and Irrigation

- Decreasing wound contamination and hence infection, “the solution to pollution is dilution.”
- Indicated for any contaminated or bite wound
- Use 50 mL to 100 mL of irrigant per cm of laceration
- Ideal solution must be: non toxic to tissues, doesn’t ↑ rate of infection or delay healing, and is inexpensive

Wound Preparation

- Anesthesia
- Wound cleansing methods
  - Irrigation
  - Scrubbing
  - Soaps
- Cleansing solution
  - NS vs.. tap water
  - Wet functioning antiseptic
- Dakin solution

Wound Debridement

- All devitalized tissue left in a wound impairs wound healing and potentiates infection.
- The infective dose of aerobic bacteria is 300k to 1 million cfu/g. In the presence of an implant (e.g. braided suture) as few as 100 cfu/g can produce infection.
- Failure to remove foreign bodies is a common trigger for litigation.
- The margin to excise on a wound is dependent on body location, on tissue appearance, the degree of maceration and contamination.

Techniques for Debriding a Wound

Image here

Wound Closure Clinical Pathways

Image here
Goals of Wound Closure

- Obliteration of dead space
- Even distribution along deep suture lines
- Maintenance of tensile strength across wound until tissue strength adequate
- Approximation and eversion of epithelial portion of wound

What are the hazards of the Patient Recovering at Home Today?

Patients recover in their Bed:
- The average Americans change their sheets every 2 weeks to 2 months.

"Household couch is 3x dirtier than a toilet."

Options for Wound Closure

- SUTURES
- TOPICAL SKIN ADHESIVES
- STAPLES
- STERI-STRIPS (Adhesive Tapes)
**Laceration Characteristics**

- Meticulous closure
- Greatest tensile strength
- Lowest dehiscence rate
- Time honored

3 out of 4 patients require follow-up care including suture removal.

**Sutures**

**ADVANTAGES**
- Meticulous closure
- Greatest tensile strength
- Lowest dehiscence rate
- Time honored

**DISADVANTAGES**
- Painful
- Risk of needle stick
- High cost
- Slow
- Operator Dependent
- Greatest tissue Reactivity
- Usually requires removal
- May leave suture marks

**RELAXED SKIN TENSION LINES**

What Size of Suture depends on location.
**Suture Classification**

- Absorbable/Non-absorbable
  - Absorbable sutures absorbed through enzymatic or hydrolytic processes within 60 days
- Natural/Synthetic
  - Lower infection rates with synthetic
- Braided/Monofilament
  - Braided sutures consist of several strands either braided or twisted together
  - Monofilament sutures are a single strand of material, lower infection rates

**In Vivo Most Common Suture Inflammatory Response**

- Website or chart showing inflammation responses for different sutures.

**Critical Wound Healing Period**

- Skin: 5-7 Days
- Mucosa: 5-7 Days
- Subcutaneous: 7-14 Days
- Peritoneum: 7-14 Days
- Fascia: 14-28 Days

**Table showing healing times for different tissues.**
1970's intro of synthetic absorbable sutures
Today – OR suture mix ≈ 80% absorbable/ 20% non-absorb
Opposite for today’s ER and Urgent Care facilities

"Nonabsorbable sutures, such as nylon, long have been the standard material for use in closure of skin wounds, with absorbable suture reserved for use in closure of deep tissue layers. Recent literature calls this practice into question and provides evidence that absorbable suture may be appropriate for skin closure."

Other Studies
Synthetic Absorbable Suture

- Superior pliability and handling
- Inert in tissues
- For procedures that require high initial tensile strength diminishing over 2 weeks
  - Tensile strength at 7 days 60%, 14 days 30%
  - Strength lost by 28 days
  - Subcuticular closure and soft tissue approximation
  - Underlying suture used with high tension wounds

It takes just one to get it done...

MONOCLOSURE

MONOCRYL Plus
One suture for two layered closure
- Deep
- Skin (Percutaneous)
Better / Faster Closure

Synthetics With a Zone of Inhibition

Antibacterial Sutures kill bacteria on the suture and inhibit bacterial colonization of the suture\(^1\)-\(^3\)

Zone of Inhibition – Areas of inhibited bacterial growth for Plus Antibacterial Sutures

Topical Skin Adhesives (TSAS)

Why use TSAS?
- Simple
- Rapid
- Strong Closure
- Occlusive Dressing
- Effective Microbial Barrier
- Cost effective flaps,
- Reduce needlestick risk
- Less Pain and Anxiety
- Reduce Follow Up
- Excellent Cosmesis
- Ease of wound care
- Gentle on Tissues:
  - fragile skin,
  - skin tears, grafts

Use of TSAS
INDICATIONS
- Easily approximated lacerations and incisions
- Lacerated/Avulsed fragile skin
- Nail bed repair
- Finger tip amputations
**Closure of Skin Tear**

**Use of TSAS**

**CONTRAINDICATIONS**
- Infection
- Unable to achieve hemostasis
- Heavy contamination
- Bites, punctures, crush wounds
- Mucosal surfaces
- Hair bearing area
- High tension areas
- Allergy to CA, formaldehyde

**DERMABOND – Microbial Barrier**
- DERMABOND seals out Gram-positive, Gram-negative and drug resistant (MRSA, MRSE) bacteria that lead to infection.
- Microbial penetration barrier shows >99% efficacy for 72 hrs from the following microorganisms:
  - S. epidermidis
  - E. coli
  - S. aureus
  - P. aeruginosa
  - E. faecium

References:
Comparison of TSA and Sutures

- Similar infection rates
- Similar dehiscence rates
- Similar cosmetic results
- Faster
- More cost effective
- Greater patient satisfaction
- Less painful
- Antibacterial effect
- Eliminates risk of needle sticks
- No suture removal

Lloyd et al. Em Med Clin N Am 2007

Got Strength?
Pounds of Force per Inch

Closure of a Skin Tear

April 2011
Near Amputation in 10 mos old

- Image here

Repairs with absorbable suture then coated in Dermabond

- Image here

Dermabond Nailbed Repair

- Image here
Small finger Laceration Repair

- Image here

April 2011

Wounds < 2cm treated with irrigation and bandage only – outcome same as complete wound care with suturing. Quinn et al, BMJ 2002
Finished after applying splint. Total time – 3 minutes.
Closure Technique – Staples

- Faster than sutures
- Equivalent cosmesis and cost effectiveness
- Staples indicated for use on extremities, trunk, scalp; not for use on face, neck, hands or feet
- Avoid on scalp if anticipating MRI or CT

Staple repair

- Poor tensile strength – high dehiscence rate
- Require adhesive adjuncts (benzoine), which increase local inflammatory reaction and infection rate
- May be used with tissue adhesive or after suture removal to reduce wound tension
- Little usefulness in primary care setting

Adhesive Tapes
**Closure Options**

<table>
<thead>
<tr>
<th></th>
<th>OCTYL SKIN ADHESIVES</th>
<th>ANTI-BACTERIAL SUTURES</th>
<th>SUTURE STAPLES</th>
<th>STRIPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closure Strength</td>
<td>Equivalent to 4.0</td>
<td>Equivalent to 4.0</td>
<td>Stronger</td>
<td>Weak</td>
</tr>
<tr>
<td>Microbial barrier</td>
<td>Yes</td>
<td>Zone of discomfort</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Cosmesis</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Incarent</td>
</tr>
<tr>
<td>Patient Comfort - showering</td>
<td>Can Shower</td>
<td>Not recommended for period of time</td>
<td>Not recommended for period of time</td>
<td>Not recommended for period of time</td>
</tr>
<tr>
<td>Ease of Care</td>
<td>Easy</td>
<td>Complicated</td>
<td>Complicated</td>
<td>Complicated</td>
</tr>
<tr>
<td>Skin to bacterial contamination</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Removal</td>
<td>Sloughs off naturally</td>
<td>May need removal</td>
<td>Need removal</td>
<td>Self-removal</td>
</tr>
</tbody>
</table>

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**Wound Repair: Avoiding the Pitfalls**

- Clean it
- Examine it – thoroughly in a well lit, bloodless field
- Debride it
- Close dead space
- Minimize wound tension and evert wound edges
- Document it!
- Discharge it – clear D/C instructions & arrange follow up (especially for moderate and high risk wounds)
- Consult it – when deep tissue injury or when in doubt

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**SUTURING TIPS AND TECHNIQUES**

- Clean it
- Examine it – thoroughly in a well lit, bloodless field
- Debride it
- Close dead space
- Minimize wound tension and evert wound edges
- Document it!
- Discharge it – clear D/C instructions & arrange follow up (especially for moderate and high risk wounds)
- Consult it – when deep tissue injury or when in doubt

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April 2011
“Just because you get away with it, doesn’t mean you did it right. And just because you did it right, doesn’t mean you couldn’t do it better.”

Moving to the Suture lab portion!

- Start of the hands on workshop. Images to large to email
- Total of four techniques
  - Simple closure
  - Internal vs external suturing
  - Use of TSA
  - Under dermal suturing
- These techniques are also on table cards for instruction purposes.