BASIC WOUND MANAGEMENT

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"The doctor will be with you tomorrow as he believes that time heals all wounds."

LEARNING OBJECTIVES

- Describe the phases of wound healing
- Describe and assess various types of wounds
- Understand the various techniques for anesthetizing wounds
- Identify and understand the techniques of basic wound closure including the use of skin adhesive, staples and simple interrupted sutures
- Identify and understand the techniques of more advanced wound closure including the use of subcutaneous sutures and mattress sutures

WOUND HEALING

- Inflammatory phase
  - Hemostasis
- Proliferative phase
  - Epithelialization
  - Neovascularization
  - Collagen synthesis
- Remodeling phase
  - Wound contraction and remodeling

32 minutes

2-3 days

17 days

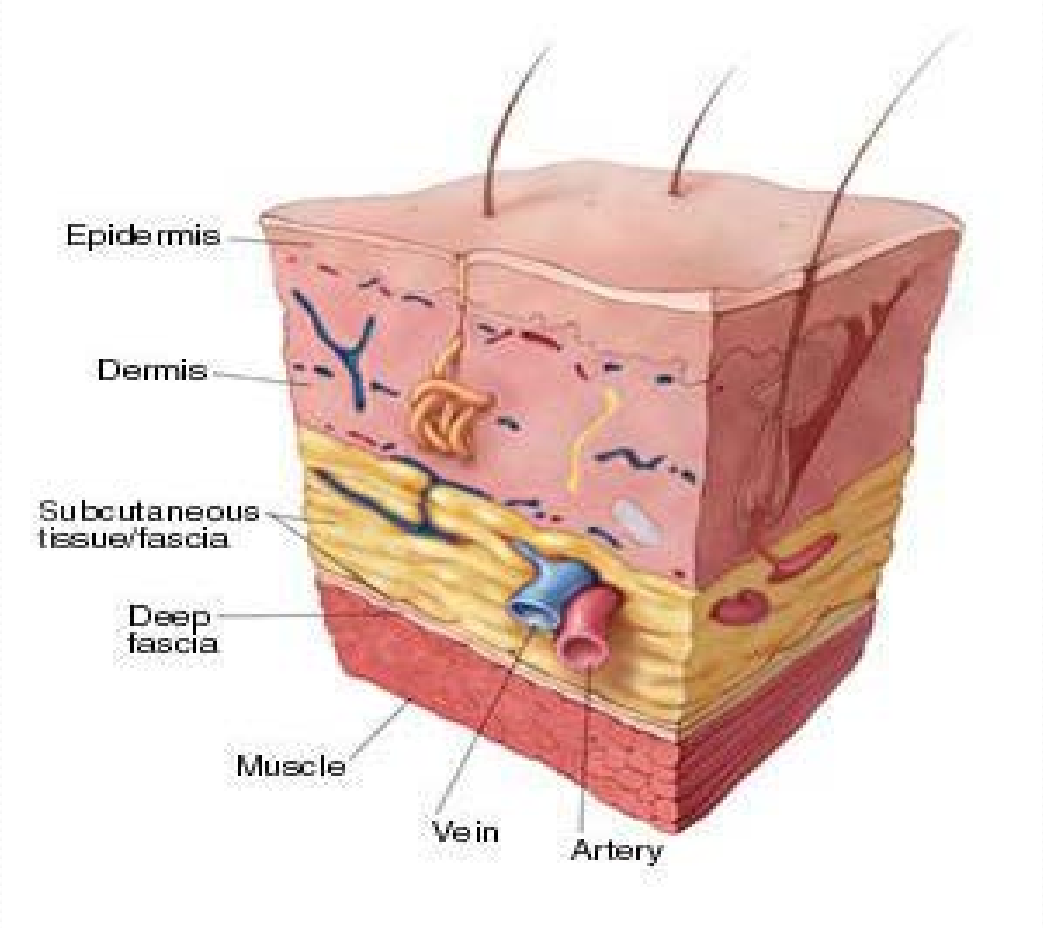
30 days

WOUND ASSESSMENT - HISTORY

- Time Since Injury
  - Suture up to 12 hrs, 24 hrs on face (Increase risk of infection the longer you wait)
  - "Golden Period": 6-8hrs
- Mechanism of Injury
  - Blunt v. sharp v. crush v. shearing
- PMH (Immunocompromised?); Medications; Allergies
- Health Status
  - Tetanus Immunization (DTAP 2, 4, 6, 15-18 mos, Td 5-7 yrs, Tdap at 11)
  - Tetanus Q 5-10 yrs, 5 years for tetanus prone wound (DIRTY)

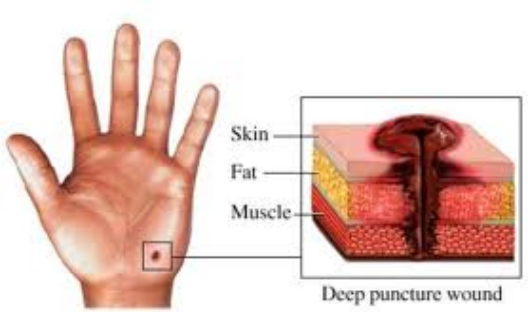
WOUND DESCRIPTION – PHYSICAL EXAMINATION

- Location
- Length/extent
- Depth
  - Through epidermis, dermis, superficial fascia, fat exposed?
- Condition
  - Clean, contaminated/foreign body, sharp, irregular



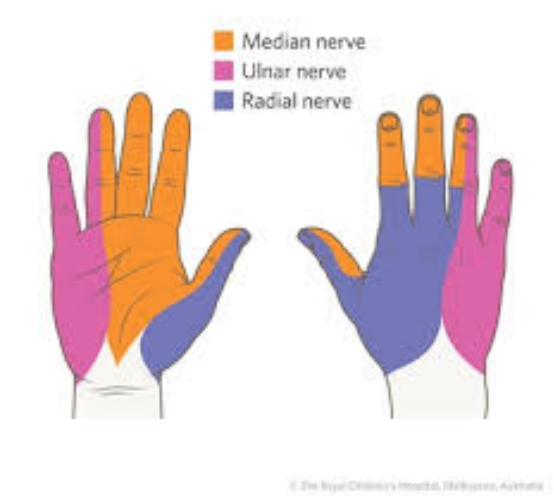
TYPES OF WOUNDS

- Abrasions
- Punctures
- Avulsions
- Lacerations
  - Tidy v. Untidy



FUNCTIONAL EXAMINATION

- Sensory (Is there nerve damage?)
- Motor (Is there a tendon injury?)
- Assess for vascular damage
  - Control bleeding if present
- Palpate bones



WOUND CLOSURE

- **Primary Intention (Primary Closure)**
  - Wound is closed immediately after injury allowing for optimal healing; improves cosmesis
- **Secondary Intention**
  - Wound heals without closure (ie: infected wounds, animal bites, ulcers)
- **Tertiary Intention (Delayed Primary Closure)**
  - Usually 3-5 days later; for wounds heavily contaminated or those with extensive damage; rare in kids

WOUND PREPARATION

- Pediatric concerns
  - Consider papoose, if necessary
  - Parent holding techniques
  - Distraction techniques
  - Anxiolysis - Moderate sedation no longer an option in the outpatient setting
- Always anesthetize before cleansing and irrigation
- Local anesthesia
  - LET
  - Local infiltration
  - Peripheral nerve block

LET – TOPICAL ANESTHETIC

- Lidocaine (4 percent), Epinephrine (0.1 percent), and Tetracaine (0.5 percent)
- Advantages:
  - Well tolerated
  - Painless administration
  - Does not distort local anatomy
- Caution:
  - End artery areas (e.g., nose, fingertips and toes)
  - Mucous membranes

APPLICATION OF LET

- Gel
  - Drip directly into wound and cover with tegaderm
- Liquid
  - Remove any blood coagulum
  - Saturate piece of cotton or gauze about same size as wound (max dose is 0.1 cc/kg)
  - Place the pledget directly into wound and hold in place with tegaderm
  - Leave in place for 20-25 minutes until blanching of skin

ANXIOLYSIS – INTRANASAL MIDAZOLAM

- Dose:
  - **0.2-0.5 mg/kg**, can repeat after 5-15 minutes, max 0.5mg/kg and max dose 10mg (0.4mg/kg ideal)
  - Vital Signs pre and post
- Caution:
  - Autistic children may have paradoxical reaction
  - Children <1 year old

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INJECTING LOCAL ANESTHESIA

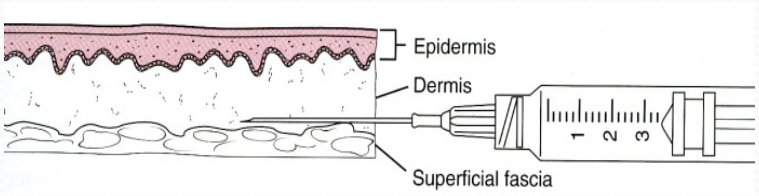
- Lidocaine and Lidocaine with Epinephrine (Max Lido dose is 4.5mg/kg of 1% and 7mg/kg of 1% Lido w/Epi)
  - Epi increases duration of action and reduces bleeding
  - Very useful in bloody areas like the scalp and face
  - Not indicated in areas with terminal circulation
  - Onset of action: Immediate

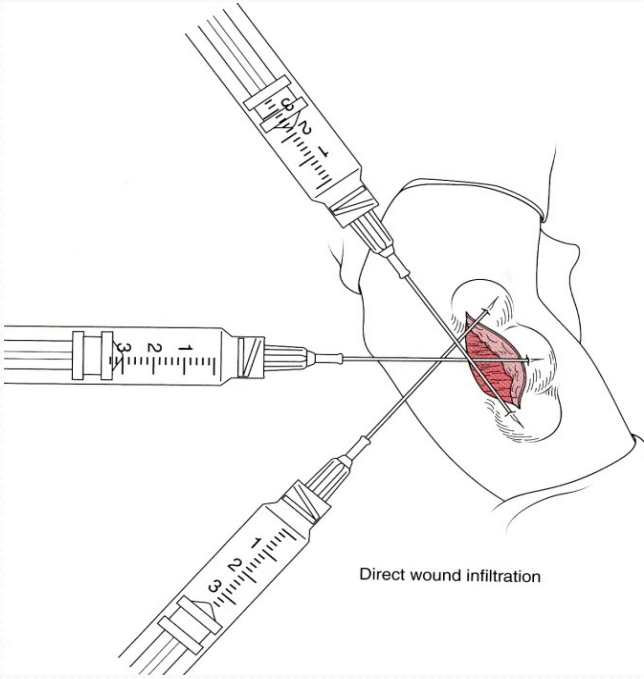
REDUCING THE PAIN OF INJECTION

- Buffer the lidocaine
  - Add 1cc of bicarbonate per 9cc's of 1% lidocaine
  - Decreases onset of action and increases intensity
  - Reduces shelf life to 7 days (3 with epi)
- Choice of needles and syringe
  - Smaller needle is better but harder
  - Learn with 25g, advance to 30g
  - Smaller syringe forces slower injection

DIRECT WOUND INFILTRATION

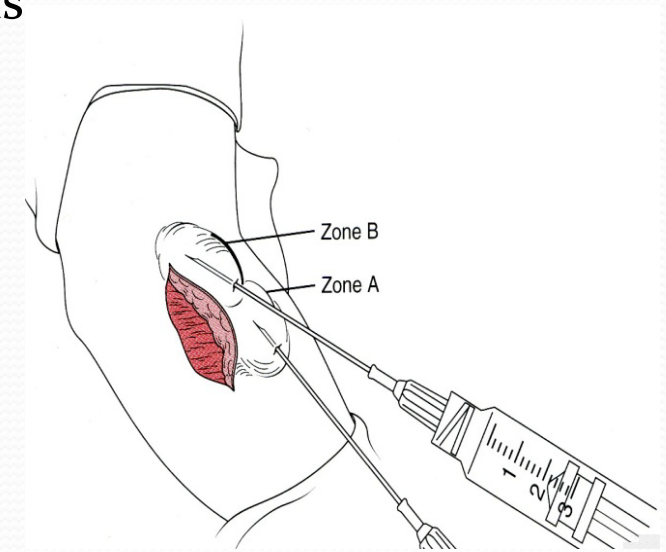
- Indications:
  - Clean, open wounds
- Technique:
  - Plane is parallel to and beneath the dermis and directly above superficial fascia
  - Aspirate, inject
  - Remove needle and inject at adjacent site just inside margin of previous anesthesia
  - Repeat until all edges are numb





FIELD BLOCKS

- Indications:
  - Requires fewer needle sticks (less pain)
  - Preferred in grossly contaminated wounds
- Technique:
  - Inject in same plane as direct
  - Requires longer needle (1 ¼ to 2 inches)
  - Insert into the **skin** at one end
  - Advance needle to hub, aspirate, then slowly inject as you track backwards
  - Reinsert at the distal end of first track
  - Repeat until all areas numb



PERIPHERAL NERVE BLOCKS

- Very useful in anesthetizing an entire area
- Requires less fluid volume and fewer needle punctures
  - No epi recommended although probably ok
- Onset is quick, usually 5-10 minutes
- Most common - finger and toe procedures
  - Laceration repair
  - Drainage of paronychias
  - Nail removal

WOUND CLEANSING SOLUTIONS

- **Betadine**
  - Strongly bactericidal against both gram-negative and gram positive
  - Solution minimally toxic to wound tissue however scrub can

    be very toxic (used for intact skin prep)
- **Hydrogen peroxide**
  - Weak antibacterial and naturally hemolytic
  - May be useful in wound encrusted with blood

THE SOLUTION TO POLLUTION IS DILUTION

- Irrigation is more effective than antibiotics in preventing infection
- Use larger syringe to deliver saline under high pressure (splash guard) and direct into wound
- Saline v. Tap Water
- 10:1 ratio (NS: Betadine)
- How much?
  - Clean, tidy wounds – 100cc/cm
  - Untidy wounds will require more

DEBRIDEMENT

- Indications:
  - Visible contamination remains despite cleansing and irrigation
  - Turns jagged wound into smooth one that is easy to close
- Technique:
  - #15 blade
  - Spare as much skin as possible

WOUND EXPLORATION

- Any suspicion for a foreign body – Get x-ray
  - Glass, gravel and metal are radioopaque
- Lacerations near a joint capsule
- Lacerations over tendons
- Scalp lacerations that are large or caused by excessive force
  - Can palpate for fracture through the wound
- Lip lacerations if a tooth or fragment is missing

HEMOSTASIS

- Direct pressure with 4x4 sponge
- Epi-moistened (1:100,000) sponge with pressure for 5 minutes
- Elevate limb x 1 minute (if extremity)
- Pack wound with hemostatic gelatin foam (Gelfoam)
- Temporary Tourniquet - max 45 mins
  - Preformed rubber disposable tourniquets (Tourni-Cot)
  - Blood pressure cuff

CONSULTATION GUIDELINES

- Standard of care
  - Nothing fixed but generally held to the same standard as a surgical specialist
- Logistics of care
  - If time needed is greater than 45-60 minutes, consider consultation
- Cosmetics and patient expectation
- Continuity of care

CONSULTATION

TISSUE ADHESIVES

- Approved for use in US in 1998
- Advantages:
  - Painless, quick, easy
  - Excellent cosmetic results
  - Lower infection rate
  - No need for removal
- Limitations:
  - Limited to areas with low tension
  - Can inadvertently bond other body parts
  - More costly

WHEN TO USE ADHESIVES

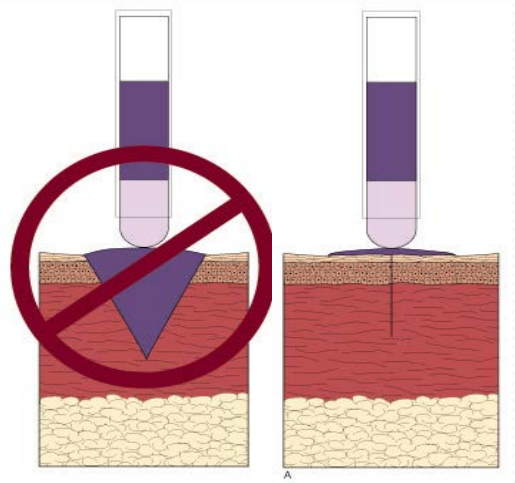
- Fresh lacerations (within “golden period”)
- Low tension and easy to approximate
- Edges clean and even and can close with no gaps
- Little or no blood oozing
- Adhesive runoff can be controlled or avoided
- Laceration follows Langer’s lines

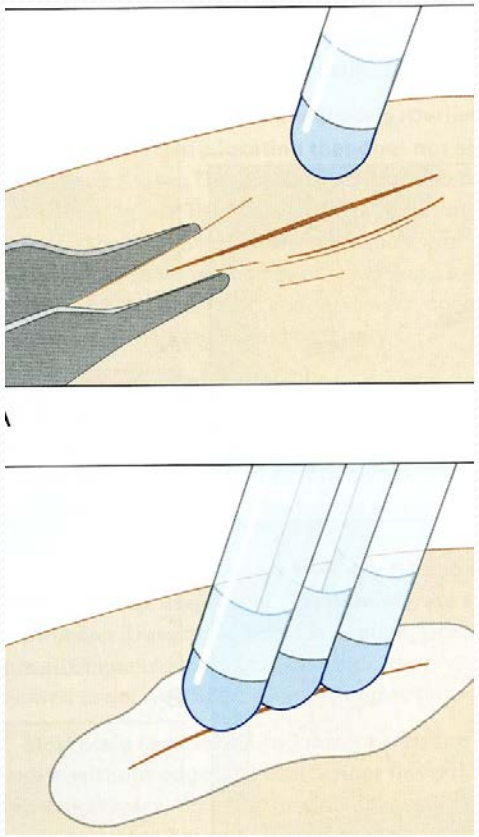
WHEN TO AVOID ADHESIVES

- Areas of high tension (ie: over a joint)
- Complex wounds, jagged edges
- Contaminated
- Patients who will pick the skin glue
- Patients at high risk for poor wound healing (ie: immunocompromised, moist areas)
- Areas with hair (scalp repair ok with some brands)

ADHESIVES - TECHNIQUE

- Position
- Protect
- Approximate
- Crush the glass vial
- Express the adhesive
- Apply the adhesive
- Unless high viscosity, repeat 2-3 times
- Wipe off excess





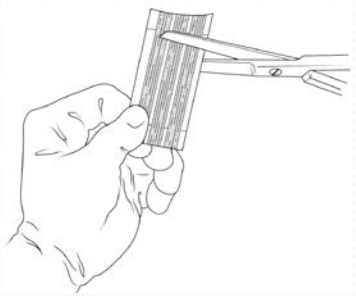
EXCELLENT OUTCOMES

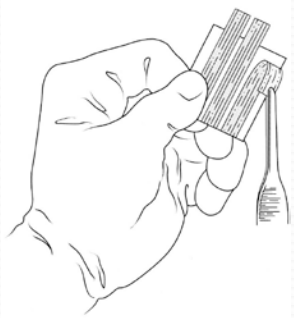
WOUND TAPING

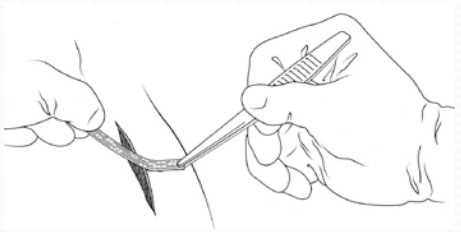
- Indications:
  - Superficial, straight lacerations under little tension
  - Flaps
  - Reinforcement of other repairs (e.g: early suture removal)
- Avoid:
  - Irregular wound
  - “Wet” wounds
  - Intertriginous areas, scalp, and joint surfaces

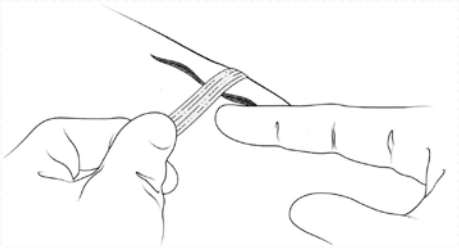
WOUND TAPING TECHNIQUE

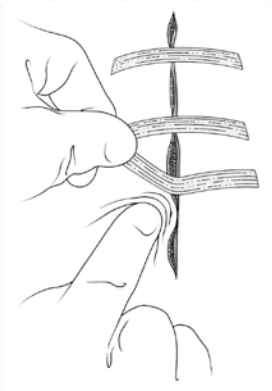
- ¼ or ½ inch wide tape
- Hemostasis/dry surface
- Apply adhesive (benzoin)

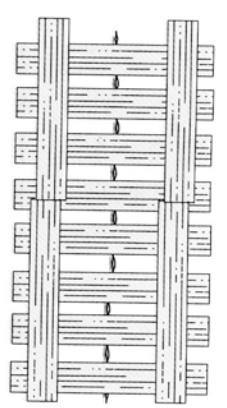










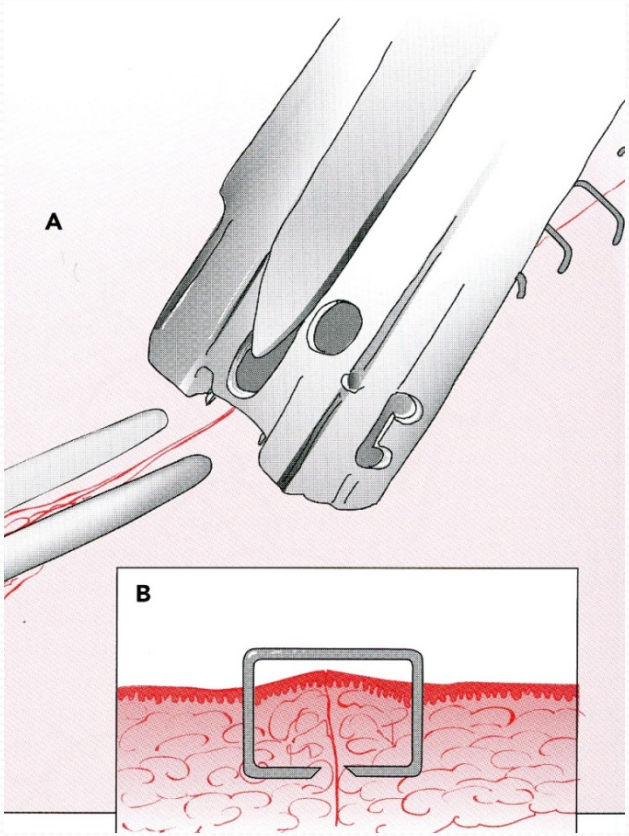


STAPLES

- Advantages:
  - Quick - scalp wounds, longer wounds
- Disadvantages:
  - Limited to relatively linear lacerations with straight sharp edges
  - Primarily scalp wounds but also trunk
  - More painful to remove than sutures

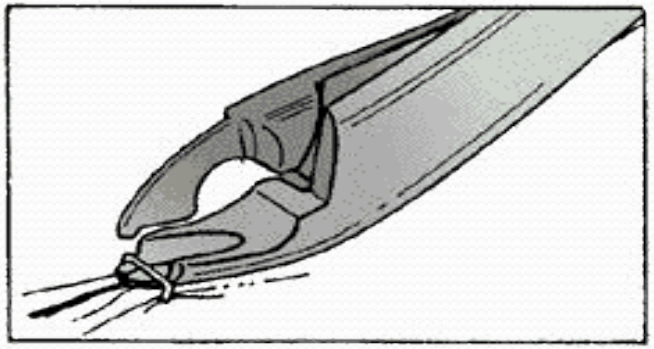
STAPLES - TECHNIQUE

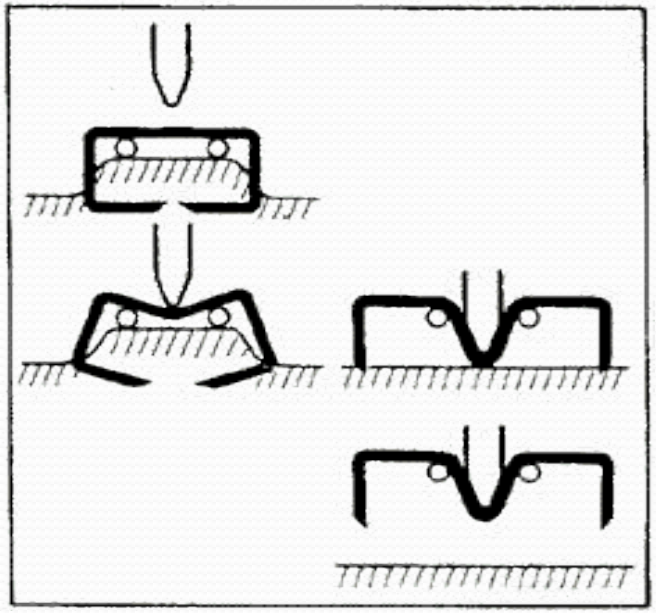
- Evert the wound edges
- Center the stapler and apply gentle pressure
- Slowly squeeze the device to eject the staple
- Pull back the wrist (“back out”) to disengage the staple from the device



STAPLE REMOVAL

- Special device
  - Lower jaw is placed under the crossbar of the staple
  - Upper jaw is closed to open the loop of the staple





ANTIBIOTIC PROPHYLAXIS

- Heavily contaminated wounds
- Bite Wounds (Augmentin/Amox-Clav)
- Open fractures
- Lacerations to ear/cartilage
- Tendon or bone involvement
- Consider in:
  - Diabetics or immunocompromised
  - Complex hand lacerations
  - Intraoral/perioral lacs
- First generation cephalosporin- Staph/Strep (Cephalexin/Keflex; Cefadroxil/Duricef)

SUTURING

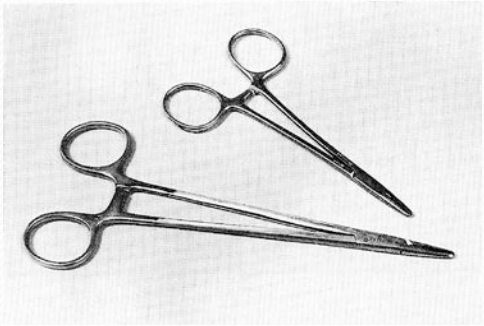
THE FUN STUFF!!!!

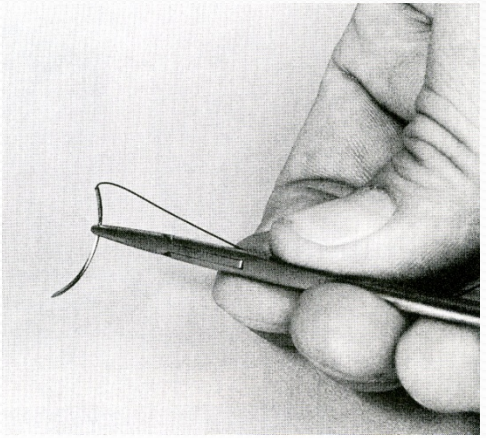
YOUR SUTURE KIT

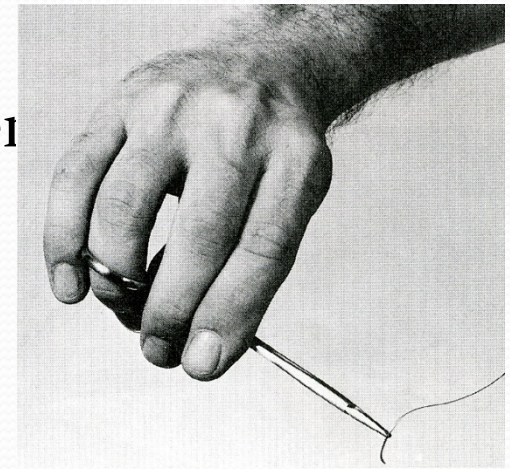
- Needle holders
- Forceps +/- skin hooks
- Scissors
- Hemostats
- Knife handles and blades or scalpel
- Suture materials
- Sterile gauze and sterile drapes

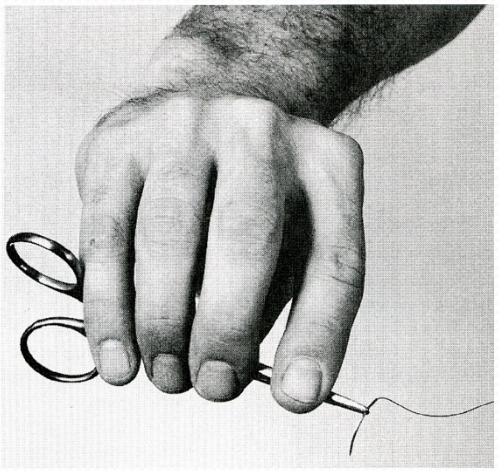
NEEDLE HOLDERS

- 4 ½ inch Webster usually enough
- Grasp needle at right angle, ~1/3 of the way down the body shaft from end to where suture attached
- "Palming It": Grasp holder close to the jaws to gain more precision



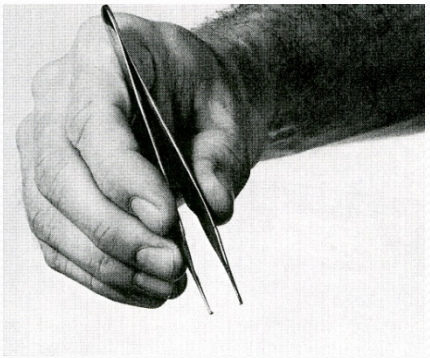






FORCEPS

- Forceps with teeth
- Hold forceps in “pencil” grasp
- Grasp subcutaneous tissue, NOT dermis and epidermis
- Can use forceps as surrogate skin hook



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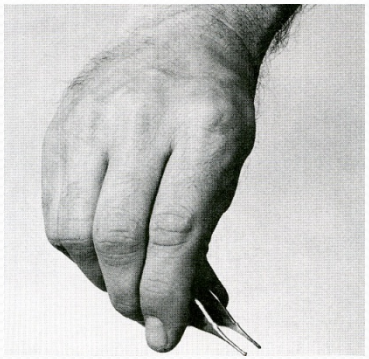

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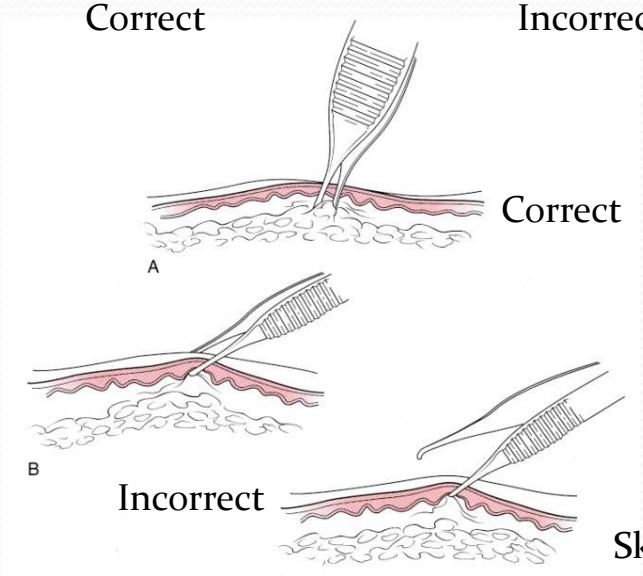


SUTURE MATERIALS

- Absorbable v. Nonabsorbable
- Suture sizes: -5-0 to 10-0 (largest to smallest)
- Most commonly used 4-0 to 6-0
- Subcutaneous sutures v. skin sutures

SUTURE MATERIALS - ABSORBABLE

Material	Structure	Tissue Reaction	Tensile Strength	Tissue Half-Life (Days)	Uses and Comments
Gut	Natural	++++	++	5–7	For mucosal closures, rarely used
Chromic gut	Natural	++++	++	10–14	For oral mucosa, perineal, and scrotal closures; can be annoying to patients because of stiffness
Polyglycolic acid (Dexon)	Braided	++	+++	25	For subcutaneous closure; coated version easier to use but requires more knots (Dexon-Plus)
Polyglactin 910 (Vicryl)	Braided	++	++++	28	Comes dyed and undyed; do not use dyed on face; irradiated polyglactin excellent for mucosal closures
Polyglyconate (Maxon)	Monofilament	+	+++++	28–36	For subcutaneous closure; less reactive and stronger than polyglycolic acid and polyglactin
Polydioxanone (PDS)	Monofilament	+	++++	36–53	For subcutaneous closures that need high degree of security; stiffer and more difficult to handle than polyglycolic acid or polyglyconate

SUTURE MATERIALS - NONABSORBABLE

Material	Structure	Tissue Reaction	Tensile Strength	Knot Security	Uses and Comments
Silk	Braided	++++	++	++++	Easy to handle but has increased potential for infection
Nylon (Ethilon, Dermalon)	Monofilament	++	+++	++	Commonly used in skin closure but high degree of memory; requires several throws for secure closure
Polypropylene (Prolene)	Monofilament	+	++++	+	High degree of memory, low tissue adhesion; good for subcuticular pull-out technique
Dacron (Mersilene)	Braided	+++	++	++++	Easy to handle, good knot security; similar to silk but less risk to tissue for inflammation and infection
Polybutester (Novafil)	Monofilament	+	++++	++++	Excellent handling, strength, and security; expands and contracts with changes in tissue edema

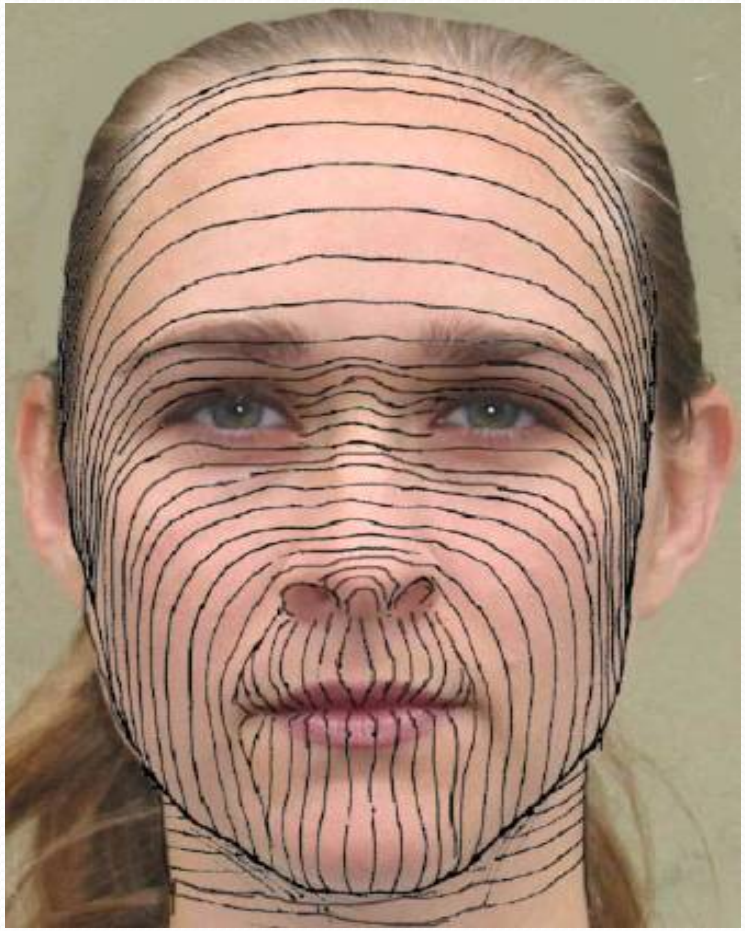
THE LANGUAGE OF SUTURING

- **Bite**
  - Amount of tissue taken when placing the suture needle in skin or fascia
- **Throw**
  - Each suture knot consists of a throw; a square knot has 2 throws
- **Percutaneous (Skin) closure**
  - Needle placed thru skin and knot tied on surface
- **Dermal (deep) closure**
  - Needle thru subcutaneous tissue with knot buried in wound
- **Interrupted vs. running sutures**

PRINCIPLES OF WOUND CLOSURE

- Layer matching
- Wound edge eversion
- Langer's Lines
- Wound tension
- Dead space
- Closure sequence and style

LANGERS LINES



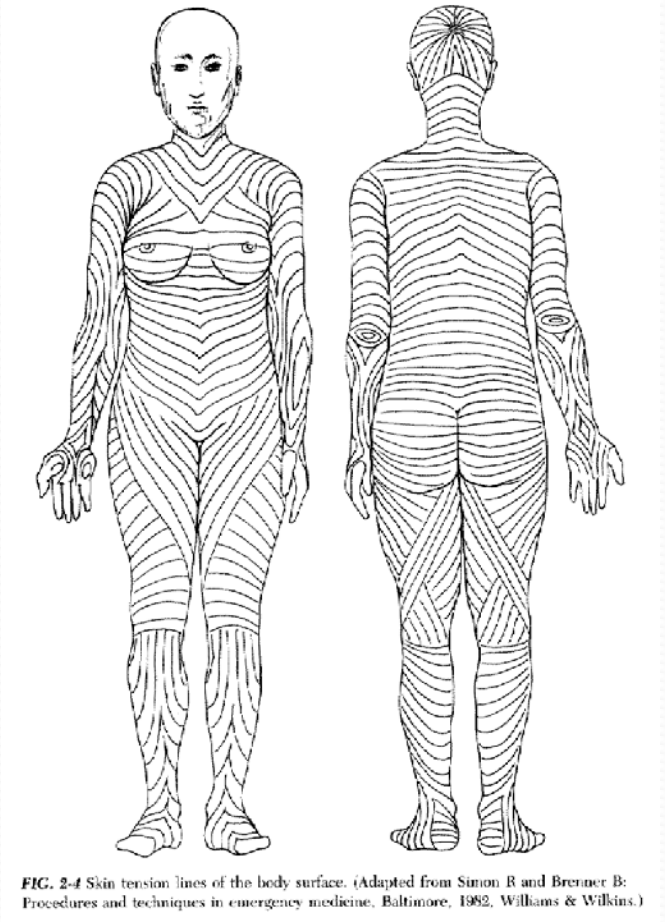
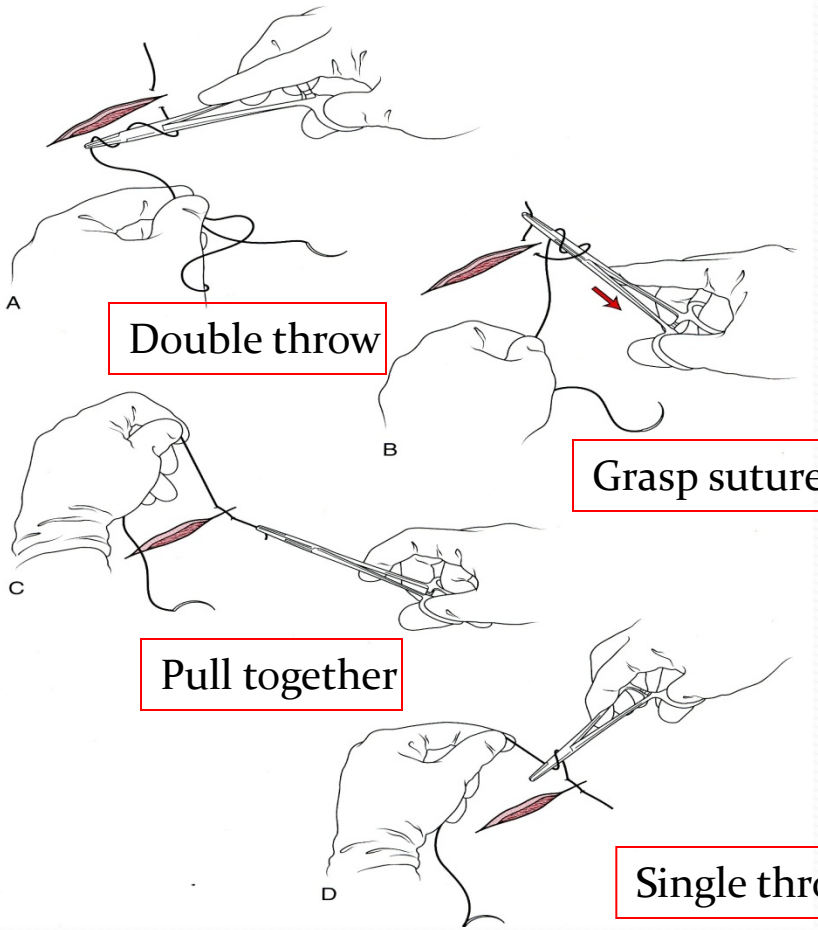
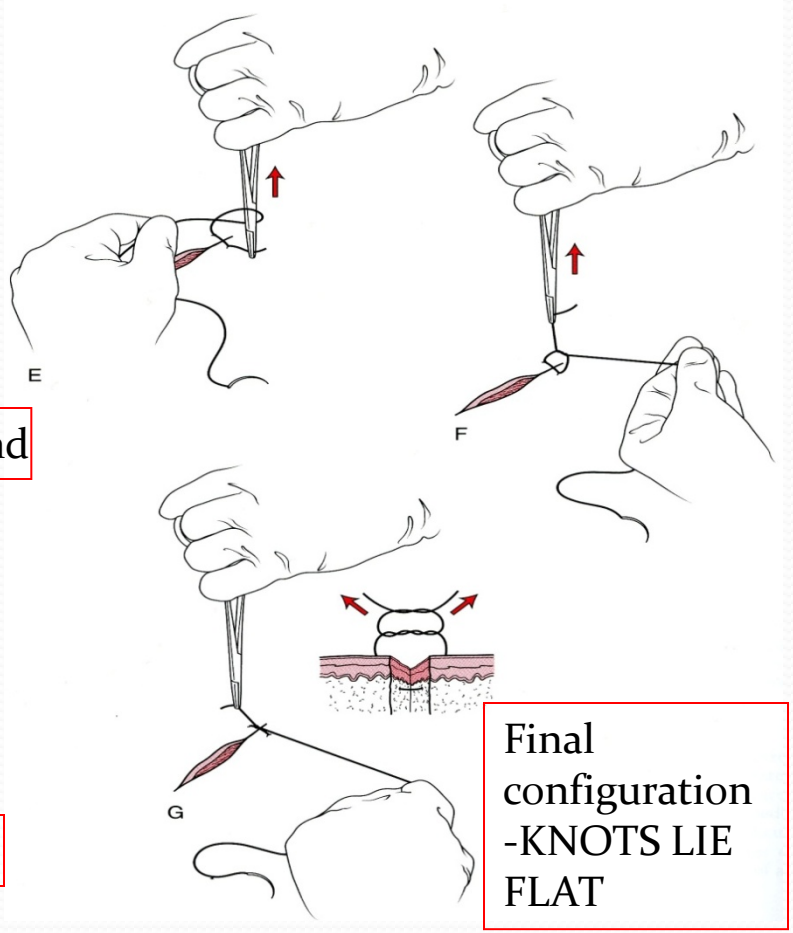


FIG. 2-4 Skin tension lines of the body surface. (Adapted from Simon B and Brenner B: Procedures and techniques in emergency medicine. Baltimore, 1982, Williams & Wilkins.)

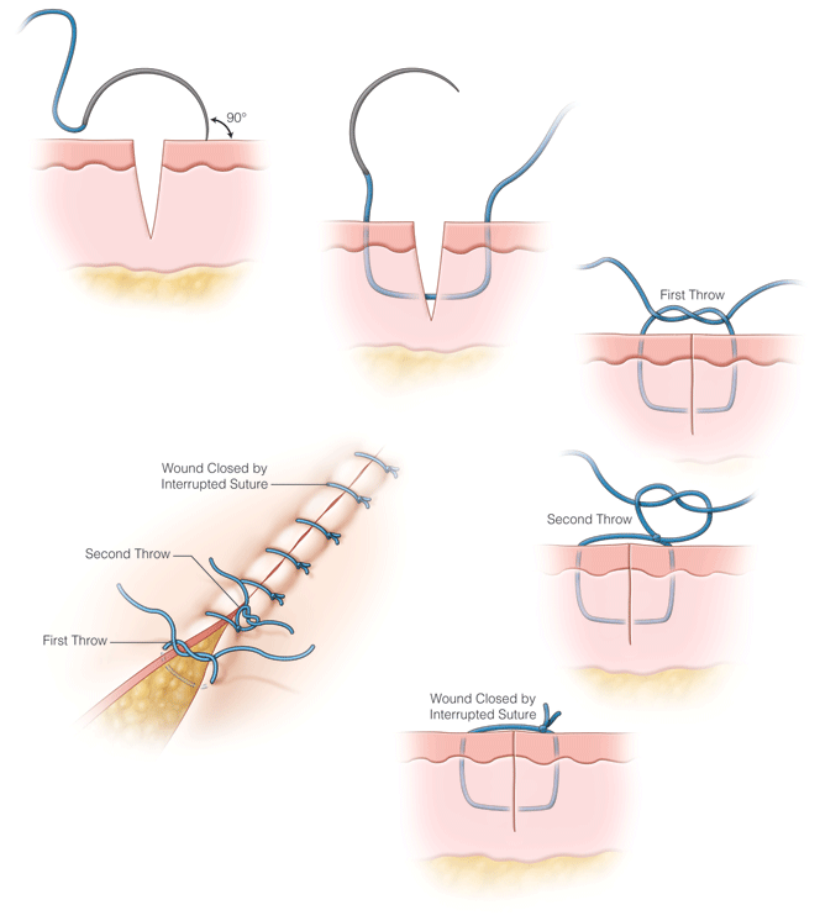
INSTRUMENT TIE – SURGEON'S KNOT



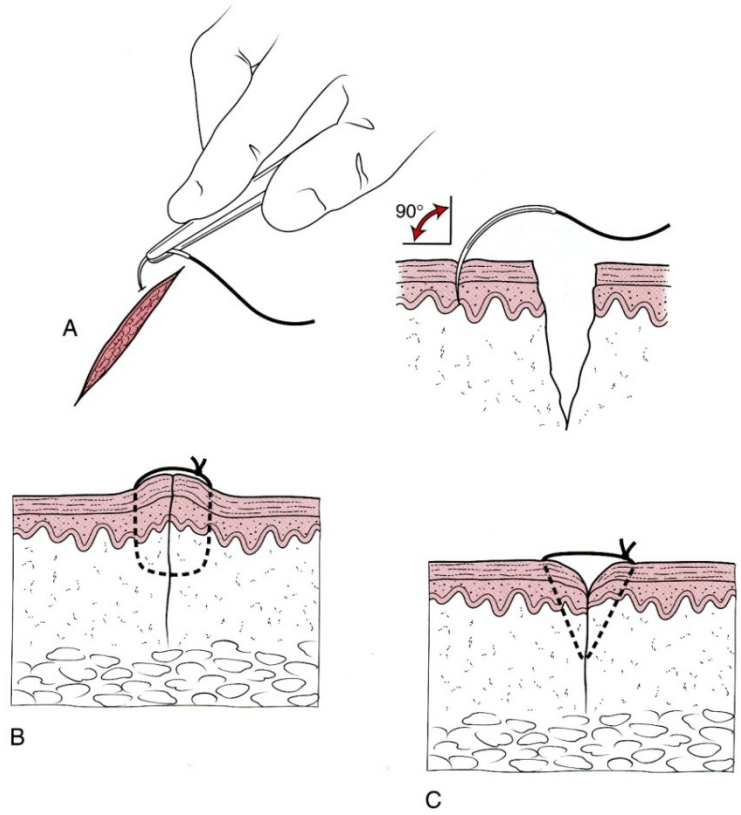


SIMPLE INTERRUPTED SUTURE

- Face: 2-3mm apart
  2-3mm from wound edge
- Elsewhere: 5mm apart, 3-4mm from wound edge
- Start midline (Divide and conquer)



SIMPLE INTERRUPTED SUTURE



Correct

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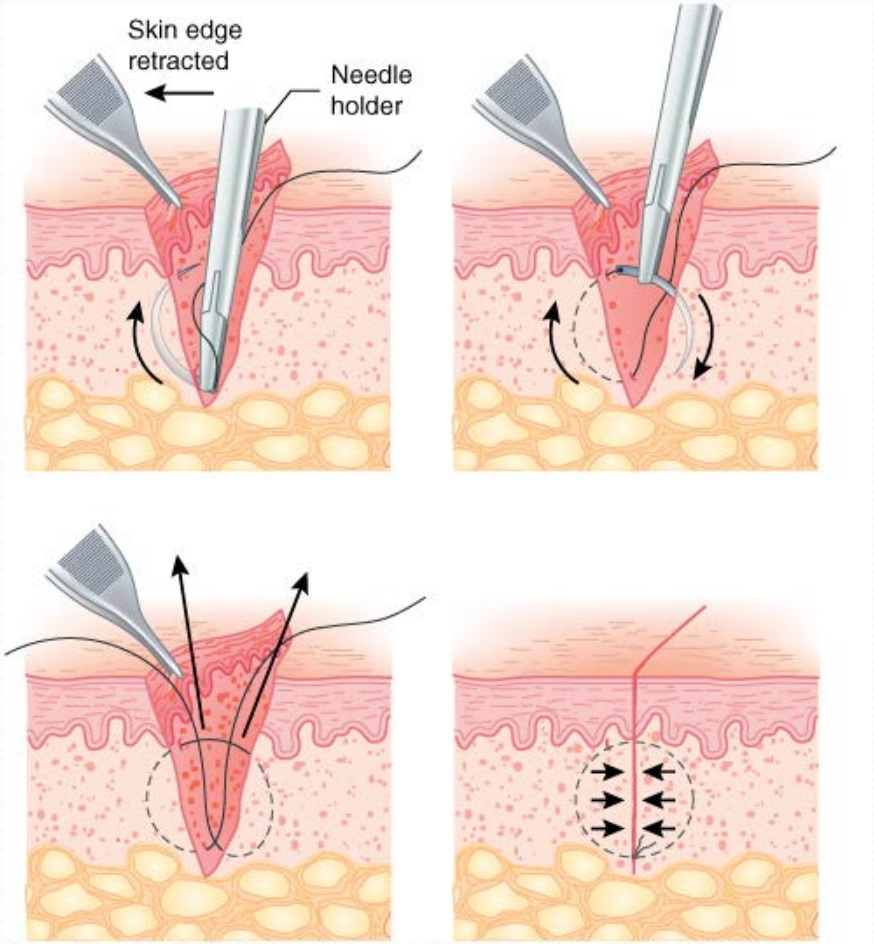
Absorbable sutures

SUBCUTICULAR CLOSURES

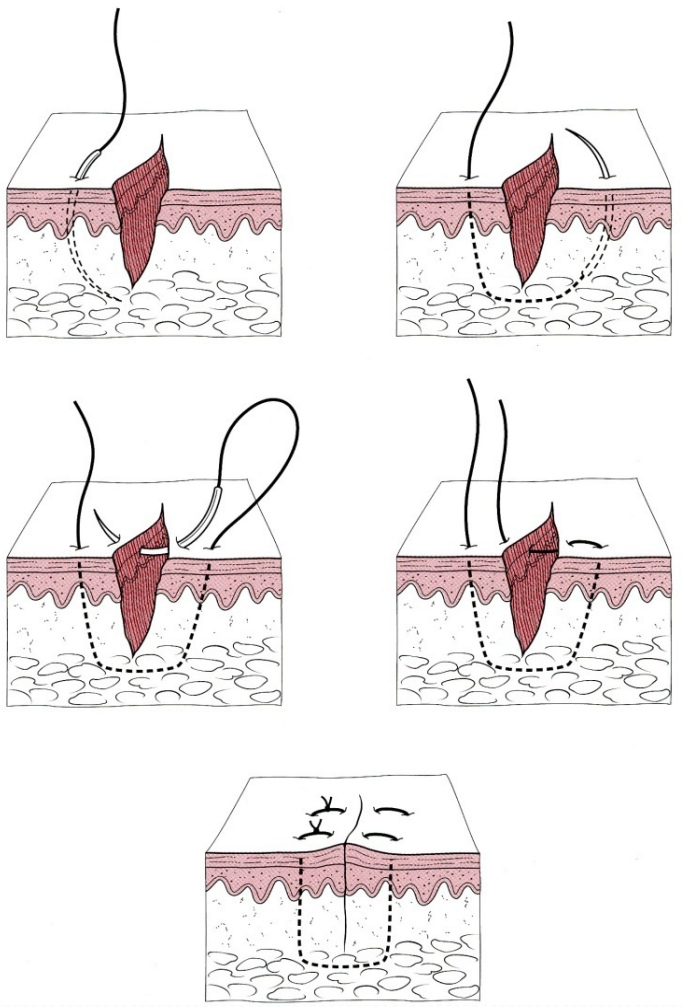
- <u>Indications:</u> Relieve tension in deeper wounds to improve cosmetic appearance
- Knot is buried

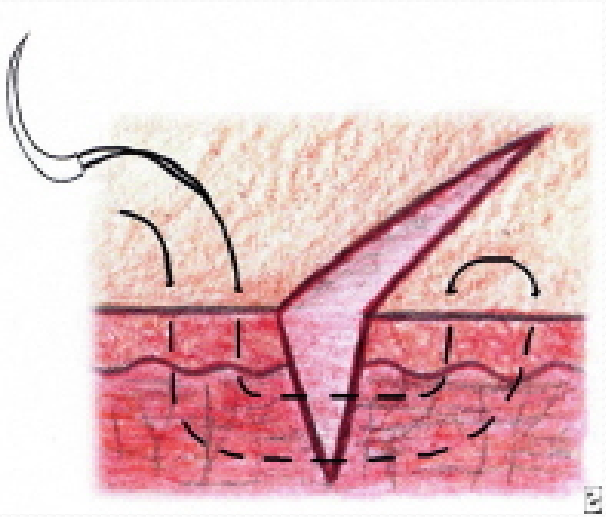


Source: Cline DM, Ma OJ, Cydulka RK, Meckler GD, Thomas SH, Handel DA: *Tintinalli's Emergency Medicine Manual, 7th Edition*: www.accessemergencymedicine.com

VERTICAL MATTRESS

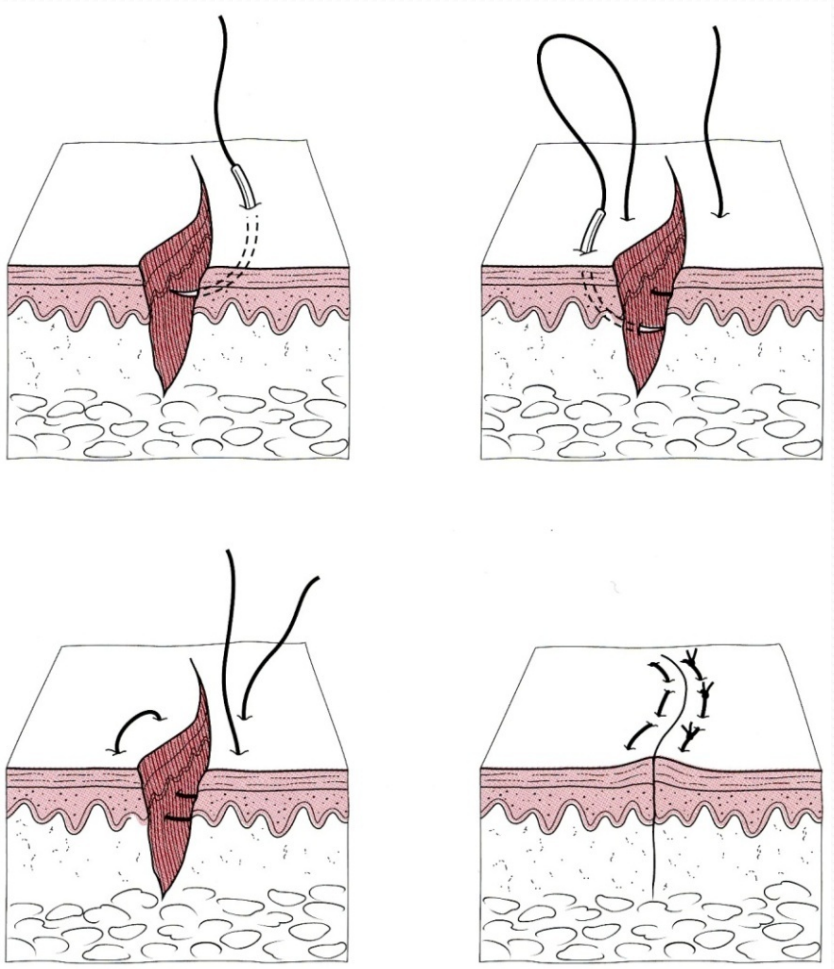
Indications: Close deep wounds to prevent dead space ie: over shin

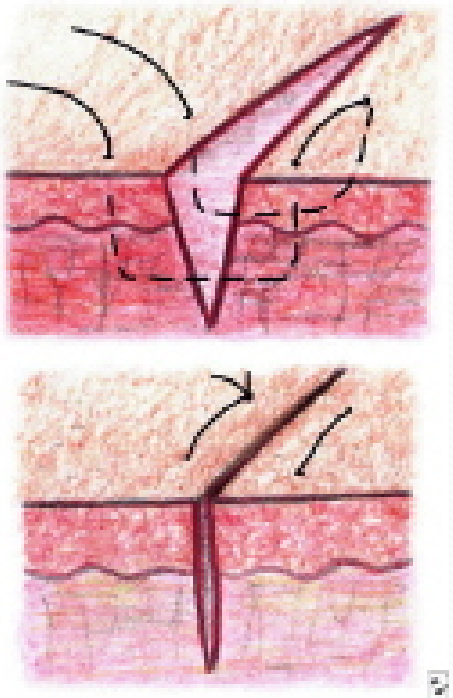




HORIZONTAL MATTRESS

Indications: Close shallow lacerations with little subQ tissue ie: over the elbow





SUTURE SIZE GUIDELINES BY BODY REGION

Body Region	Percutaneous (Skin)	Deep (Dermal)
Scalp	5-0/4-0 monofilament*	4-0 absorbable†
Ear	6-0 monofilament	—
Eyelid	7-0/6-0 monofilament	—
Eyebrow	6-0/5-0 monofilament	5-0 absorbable
Nose	6-0 monofilament	5-0 absorbable
Lip	6-0 monofilament	5-0 absorbable
Oral mucosa	—	5-0 absorbable[3]
Other parts of face/forehead	6-0 monofilament	5-0 absorbable
Trunk	5-0/4-0 monofilament	3-0 absorbable
Extremities	5-0/4-0 monofilament	4-0 absorbable
Hand	5-0 monofilament	5-0 absorbable
Extensor tendon	4-0 monofilament	—
Foot/sole	4-0/3-0 monofilament	4-0 absorbable
Vagina	—	4-0 absorbable‡
Scrotum	—	5-0 absorbable‡
Penis	5-0 monofilament	—

HOME CARE

- Keep wound clean and dry x 24hrs
- Cleanse wound gently with soap and water twice daily, then apply topical antibiotic ointment
- Avoid prolonged water exposure or soaking
- Keep the wound open to air as much as possible
- Lacerations over a joint require immobilization to avoid dehiscence
  - May need to splint finger lacs
- Watch for S/S of infection
- May need recheck in 1-2 days for high risk wounds (bite wounds, dirty wounds, complex hand wounds)

SUTURE REMOVAL BY REGION

Tissue	Number of Days
Scalp	7
Face/Mouth/Lip/Cheek	3-5
Ear	3-5
Trunk	7-10
Back	12-14
Extremities	8-10 (10-14 if over joint)
Palms	7-14
Soles	7-14

SUTURE REMOVAL

- Assess wound for healing
  - Is it well approximated?
  - Any evidence of infection?
  - Any evidence of scarring?
- Start removal at one end
  - Cut between knot and skin
  - If edges separate when a stitch is removed, wound needs more time to heal

AFTER REMOVAL CARE

- Avoid the sun: Hats, sun block
- Expose to air
- Massage the scar once healed
- OTC scar creams (Mederma, Scarguard)
- Newer-silicone based sheets to prevent collagen from rising above skin surface

TAKE HOME POINTS

- Each wound should be evaluated individually to determine which closure technique is best
- Slow administration and buffering of anesthetic solution can reduce the sting from a local anesthetic injection
- Wound irrigation and exploration are essential
- Compared with sutures, tissue adhesives have comparable cosmetic results, rates of dehiscence, and risk for infection
- It can take up to one year for a scar to achieve its final appearance

SOURCES

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- *UpToDate*
- *http://quizlet.com/19345779/surgery-midterm-flash-cards/*

QUESTIONS?

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Laceration Repair Supplies:

- Pigs feet OR fat pad/back (1 per student)
- Non latex gloves
- Suture kit (needle driver, forceps, scissors)
- Scalpels
- Suture materials (Nylon preferable 3-0, 4-0, 5-0 with 13mm and 19mm needles; and/or silk, vicryl)
- Staple gun and staple remover
- Skin Glue
- Chucks and drapes for tables
- SHARPS container
- 3cc Syringes with 25G needles and Lidocaine to show how to anesthetize the laceration

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