UW EMERGENCY MEDICINE INTEREST GROUP

A GUIDE TO THE BASIC SUTURE WORKSHOP

Introduction

History

- How long ago? (>12 hr on body or >24 hr on face should not be closed as a general rule. This may vary by institution)
- Amount of blood loss?
- Last tetanus shot? (>10 yrs needs booster, or >5 years if contaminated wound)
- Contamination / foreign body?
- Mechanism of injury (consider fracture)?
- Complicating medical conditions? (elderly, vascular disease, diabetes, etc)

Physical exam

- Signs of serious blood loss (provide initial hemostasis, pressure, elevation)
- Assess motor and sensory function (before and after closure)
- Assess 2 point discrimination distal to the injury site (if hand, assess both ulnar and radial side)
- Assess circulation distal to injury (before and after closure)
- Note size and depth of the lesion
- Visualize wound base to assure depth and lack of foreign bodies (after anesthesia)

Principles of wound care

- Minimize bacterial contamination
- Remove foreign bodies and devitalized tissue
- Achieve hemostasis
- Handle tissue gently
- Approximate, don't strangulate

Steps

- Assess
- Gather materials
- Anesthetize
- Irrigate / cleanse
- Prep
- Suture
- Bandage

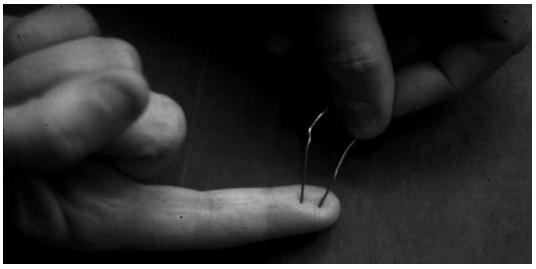


Fig. 1: 2 point discrimination can be tested with a splayed paperclip <5mm apart.

Materials

laceration tray	4X4s
sterile gloves	procedure light
suture material	mayo stand
anesthetic	chucks
irrigation kit (500cc NS)	antibiotic ointment
chlorhexidine prep	goggles

Local Anesthetics for Wound Care

Agent	**Concentration**	**Infiltration**	**Duration of block**
lidocaine	1% ,2%	Immediate	30-60 min
lidocaine w/ epi *	1%	Immediate	60-120 min
bupivacaine	0.25%, 0.5%	Slower	240-480 min
Topical	Depending	5-15 min	20-30 min

* do not use epinephrine in ears, nose, penis, fingers, and toes!

Absorbable Suture Materials

Material	**Structure**	**Tis. rxn**	**Strength**	**T ½**	**Uses**
Gut	Natural	++++	++	5-7d	Mucosal closure, rare
Chromic Gut	Natural	++++	++	10-14d	Mucosa, perineal
Dexon	Braided	++	+++	25d	Sub Q closures
Vicryl	Braided	++	++++	28d	Mucosal closures
Maxon	Monofil	+	+++++	28-36d	Sub Q closures

Non-absorbable Suture Materials

Material	**Structure**	**Tis. Rxn**	**Strength**	**Knot sec.**	**Uses**
Silk	Braided	++++	++	++++	Easy to handle
Nylon	Monofil	++	+++	++	Common for skin cl.
Prolene	Monofil	+	++++	+	High memory, sub Q pull
Dacron	Braided	+++	++	++++	Good knot security

Suture sizing by indication

Location	**superficial non-absorb**	**deep absorbable**
Scalp, torso (chest, back, abdomen), extremities	3-0 to 5-0	3-0 or 4-0
Face, eyebrow, nose, lip	6-0	5-0
Ear, eyelid	6-0	n/a
Hand*	4-0 or 5-0	5-0
Foot or sole*	3-0 or 4-0	4-0
Penis	5-0 or 6-0	n/a

* deep sutures are to be avoided in the hands and feet unless being used to repair a tendon – they may increase the risk of wound infection.

Anesthetization

Clean the area to be anesthetized with chlorhexidine or 1% betadine solution. Choose the appropriate anesthetic (for most cases this will be 1% lidocaine with or without epi). To buffer lidocaine, add bicarbonate to the solution in a 10:1 ratio. To buffer bupivacaine, add bicarbonate to the solution in a 30:1 ratio. Use bupivacaine for longer procedures, and mix with lidocaine for both rapid onset and longer duration. Draw up anesthetic in a 10cc syringe with an 18g needle. Change to 25g or 30g needle and remove all the air. Insert needle into subcutaneous tissue from within the wound margins and make a wheel under the skin. Continue along the entire wound margin to be repaired. Use plenty of anesthetic!

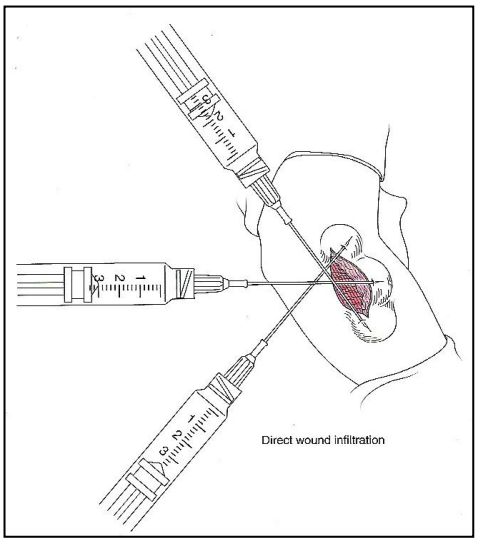


Fig. 2: local anesthesia
(Wounds and Lacerations – Emergency Care and Closure)

Wound Cleaning and Irrigation

Wearing eye protection, inspect wound for foreign bodies. Place chucks under the wound to collect drainage. Flush wound with copious amounts of normal saline. This can be done with a 30-60cc syringe with an 18g needle, IV bag with adapter, or special irrigation apparatus. Use a high pressure, direct stream in all areas of the wound. Avoid high pressure, however, on delicate tissues, such as the eye lids. A good rule of thumb is 100cc per 1cm of wound length. Once irrigated, switch to sterile gloves and cover the area with a sterile fenestrated drape. Explore the wound to assess the depth and presence of foreign bodies.

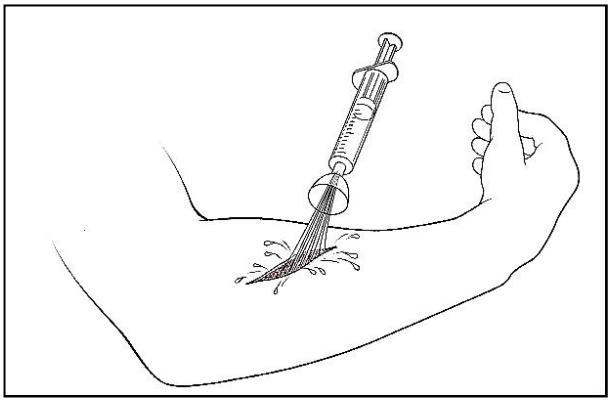


Fig. 3: high pressure wound irrigation
(Wounds and Lacerations – Emergency Care and Closure)

Basic Suturing Techniques

The simple interrupted technique is the predominant form of basic wound closure and the essential skill of the basic suturing workshop.

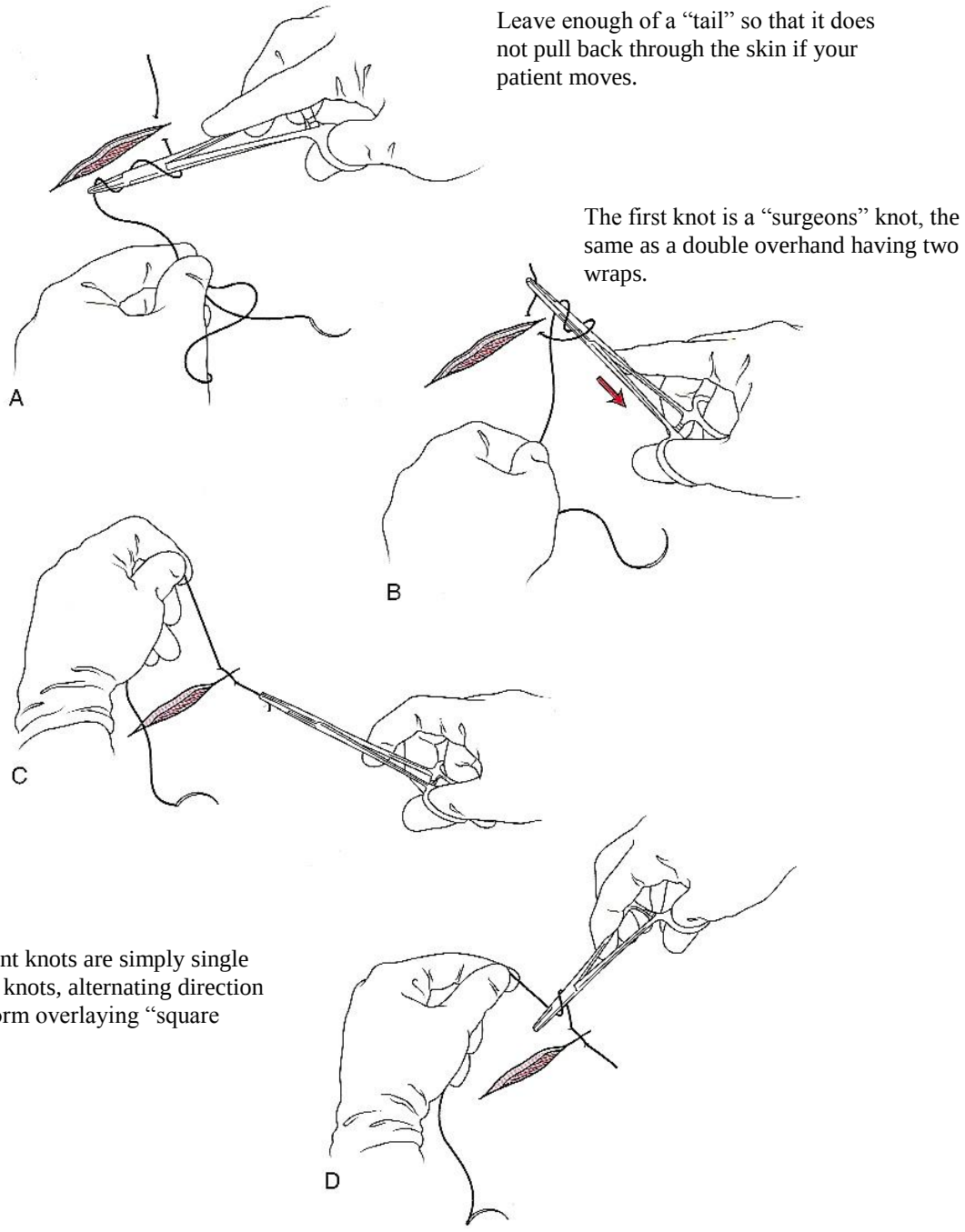
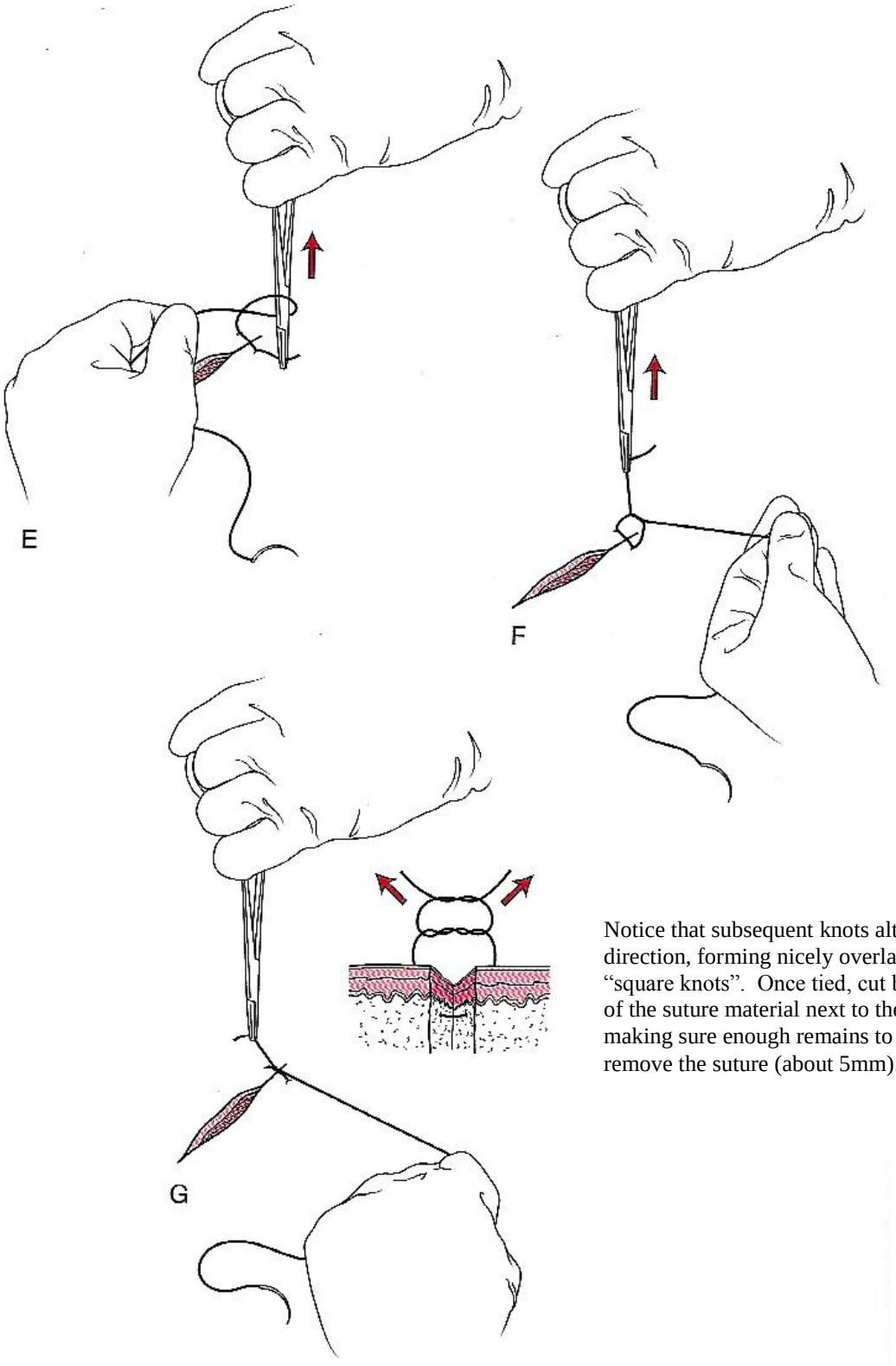


Fig. 4: simple interrupted suture technique
(Wounds and Lacerations – Emergency Care and Closure)



Notice that subsequent knots alternate direction, forming nicely overlaying "square knots". Once tied, cut both ends of the suture material next to the wound, making sure enough remains to safely remove the suture (about 5mm).

Fig. 4 cont.: simple interrupted suture technique
(Wounds and Lacerations – Emergency Care and Closure)

Larger wounds can be closed with a continuous simple suture technique. The first suture is made in the same manner as the simple interrupted, but subsequent sutures are placed without cutting the suture material. The final knot is made by taking a "bite" of the second to last pass though the tissue and tied in the usual fashion.

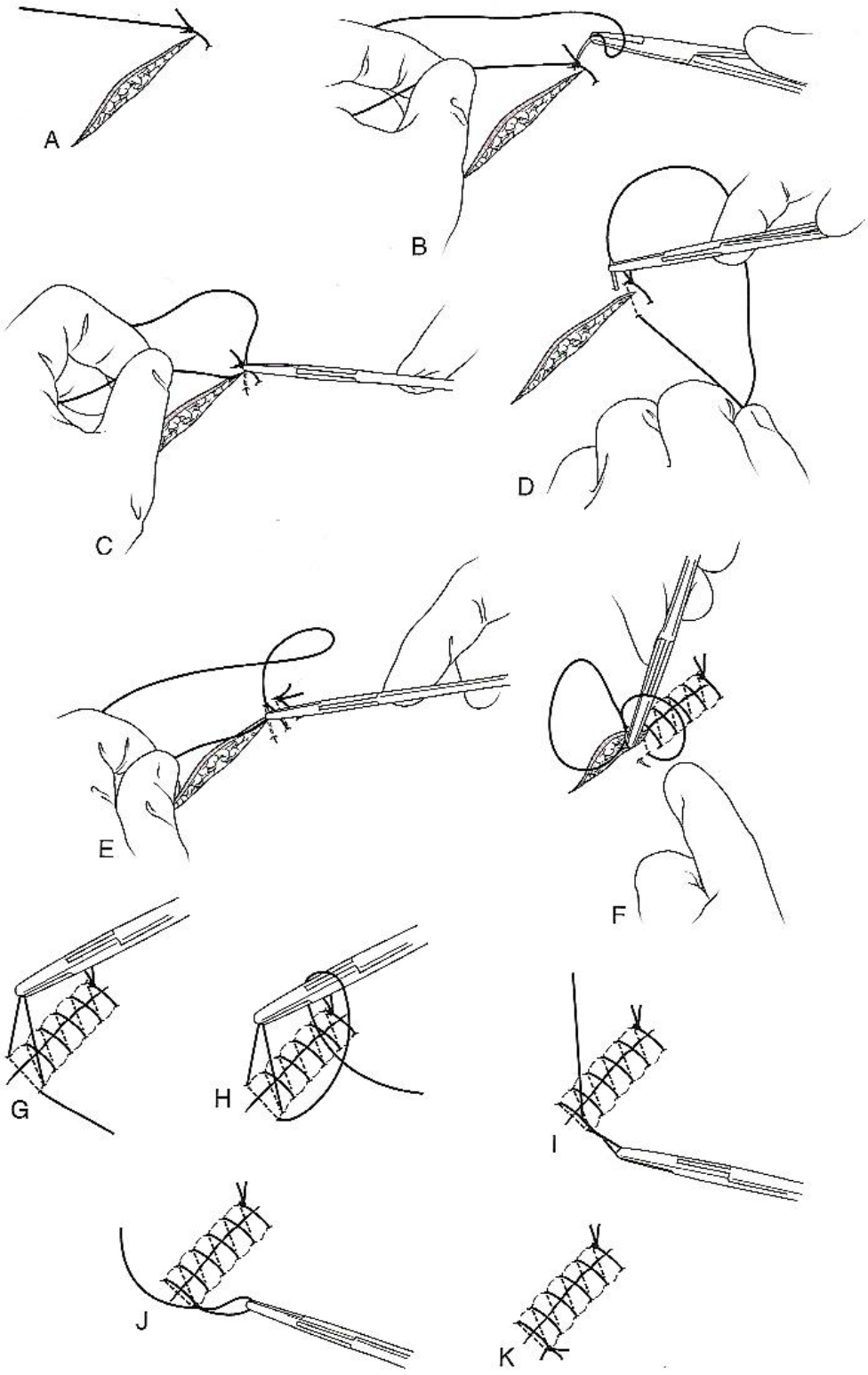


Fig. 5: continuous simple stitch
(Wounds and Lacerations – Emergency Care and Closure)

The vertical mattress suture is ideal for equalizing high-tension forces across a wound edge. They are also helpful in areas where wound edge approximation and proper "tenting" is difficult. These can be intermixed with simple interrupted sutures and removed earlier to prevent scarring. A helpful mnemonic is "far-far … near-near" meaning that you begin your first suture further away from the wound margin, and aim further away on your follow-through. The second pass through the tissue follows a similar tract, but closer (near-near) to the wound margin.

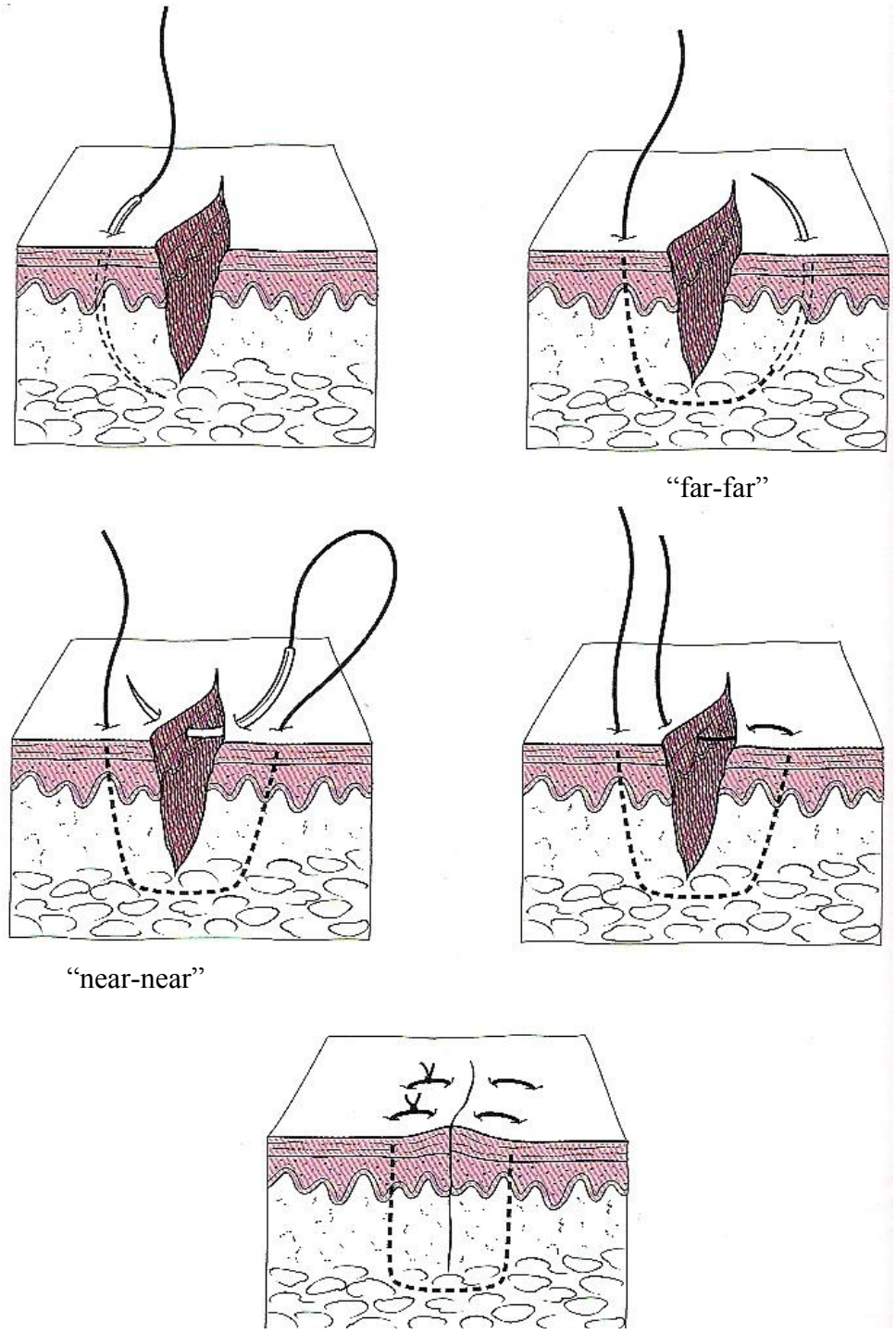


Fig. 6: vertical mattress suture
(Wounds and Lacerations – Emergency Care and Closure)

Suture Spacing

Suture should be carefully placed to avoid shearing through the tissue wall. One should also avoid strangulating the tissue by tying the knot too tight. This can cause unnecessary scarring and tissue necrosis. The distance between sutures should be roughly ½ the length of the individual sutures. Place the first suture in the center of the wound if approximation will be difficult, continuing by closing the distance to the wound edges by ½ to minimize tension forces on the tissue wall. Notice that the knots are all on the same side. This aids with suture removal.

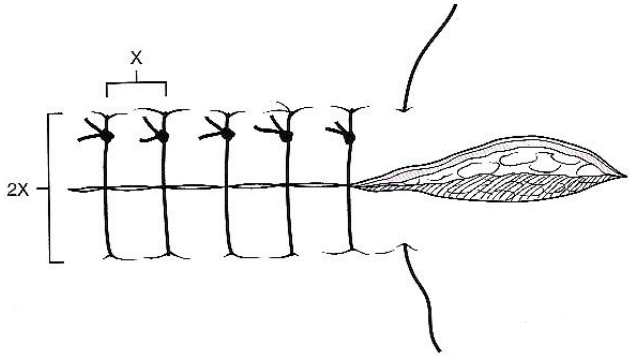


Fig. 7: appropriate suture placement
(Wounds and Lacerations – Emergency Care and Closure)

Tips

Be sure to place the needle to 90 degrees at the skin margin and rotate the needle through its arc while in the skin. On the opposite wound edge, be sure to run the needle though a symmetrical tract. This will insure level wound edge approximation. Failure to do so can result in worse approximation leading to poor wound healing and scarring. To facilitate this, keep the fingers free of the islet holes in the needle drivers.

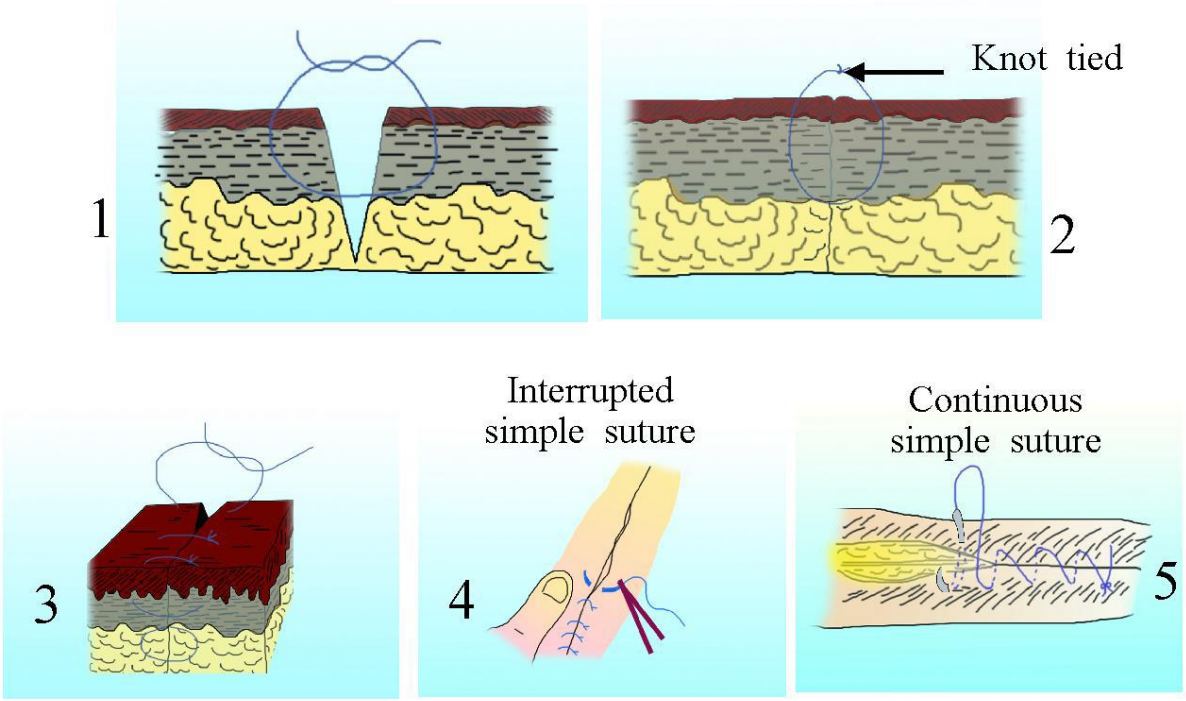


Fig. 8: putting it all together

Patient Instructions and Follow-Up

Risks associated with anesthesia and laceration repair
Complications of laceration repair include infection and wound dehiscence. A wound re-check should be scheduled for 24 to 48 hours after the wound closure if complications are likely. Other complications include scar formation, unrecognized deep-structure injury, and retained foreign body.

Tetanus shot
Any open wound is potentially susceptible to tetanus infection. A booster should be administered if the last tetanus is >10 years old (assuming the patient has received the 3 shot primary series in the past). If the wound is contaminated with debris, a tetanus booster should be considered if the previous tetanus shot is >5 years old. In the event a patient has sustained a tetanus prone wound and has not received the primary 3 shot series, they will require tetanus immune globulin and must be initiated on the primary immunization series.

Wound care
After the first 24-48 hours, patients should gently wash the wound with soap and water, dry it carefully, apply topical antibiotic ointment, and replace the dressing/bandages. Facial wounds generally only need topical antibiotic ointment without bandaging. Sunscreen spf 30 should be applied to the wound to prevent subsequent hyperpigmentation.

Suture removal
Removing sutures is generally a quick and painless procedure. Removal time considers both the potential for scarring and the required tensile strength of the wound to withstand stressors.

Area	**Removal Time**
Face	3-5 days
Neck	4-6 days
Scalp	7-12 days
Upper extremity	8-14 days
Trunk	6-14 days
Extensor surface of hands	10 days
Lower extremity	14-28 days

When to RTC / ER
Patients should be instructed to return to the clinic/ED if they note signs of infection (redness, heat, pain, puss, etc), inadequate analgesia, or suture complication. The latter may include suture strangulation or knot failure with possible wound dehiscence. It should be emphasized to patients that they return at the appropriate time for suture removal or complications may arise leading to further scarring or subsequent surgical removal of buried sutures.

Summary

Table 2. SUTURE REPAIR OF SOFT TISSUE INJURIES

Location	Anesthetic	Suture Material†	Technique of Closure and Dressing	Suture Removal (d)	Pitfalls
Scalp	Lidocaine 1% with epinephrine	3-0 or 4-0 Nonabsorbable monofilament	Interrupted in galea; single tight layer in scalp—horizontal mattress if bleeding not well controlled by simple sutures	7–12	Failure to explore wound for fracture; hematoma formation secondary to "loose" closure
Face	Lidocaine 1% with epinephrine or use field block	4-0 or 5-0 Synthetic absorbable or 6-0 nonabsorbable monofilament	If full-thickness laceration, layered closure is desirable	3–5	Failure to recognize and examine for damage to underlying structures, i.e., facial nerve parotid duct
Pinna (ear)	Lidocaine 1% (field block)	6-0 Nonabsorbable monofilament or 5-0 synthetic absorbable	Close perichondrium with 5-0 synthetic absorbable; close skin with nonabsorbable interrupted sutures—stint dressing	4–6	Hematoma formation secondary to improper or no dressing
Eyebrow	Lidocaine 1% with epinephrine	4-0 or 5-0 Synthetic absorbable and 6-0 nonabsorbable monofilament	Layered closure	4–5	Perpendicular excision rather than one parallel to direction of hair follicles; shaving of eyebrows
Eyelid	Lidocaine 1%	6-0 Nonabsorbable monofilament	Single-layer horizontal mattress, interrupted or running	3–5	Failure to examine for globe injury or to appreciate injury to tarsal plate
Lip	Lidocaine 1% with epinephrine or use field block	4-0 or 5-0 Synthetic absorbable in mucosa, muscle, and intradermal layer; 6-0 nonabsorbable monofilament	Three layers (mucosa, muscle, and skin) if through and through; otherwise, two layers	3–5	1 mm or greater malalignment of vermillion border results in cosmetic deformity
Oral cavity	Lidocaine 1% with epinephrine or IV sedation (in children)	4-0 Synthetic absorbable	Simple interrupted or horizontal mattress; layered closure if muscularis of tongue involved	7–8 or allow to dissolve	Inadequate sedation and exposure (particularly in children) for necessary procedure
Neck	Lidocaine 1% with epinephrine	4-0 Synthetic absorbable intradermal; 5-0 nonabsorbable monofilament	Two-layered closure for best cosmetic results	4–6	Failure to appreciate implication of zone I or zone III injuries; delay in airway management
Abdomen	Lidocaine 1% with epinephrine	4-0 Synthetic absorbable; 4-0 or 5-0 nonabsorbable monofilament	Single or layered closure	6–12	Failure to use local wound exploration as an initial screen and aggressively follow up with further diagnostic procedures
Back	Lidocaine 1% with epinephrine	4-0 Synthetic absorbable; 4-0 or 5-0 nonabsorbable monofilament	Single or layered closure	6–12	Failure to appreciate possibility of renal or diaphragmatic injury
Chest	Lidocaine 1% with epinephrine	4-0 Synthetic absorbable; 4-0 or 5-0 nonabsorbable monofilament	Single or layered closure	6–12	Exploration of wound may cause hemorrhage or pneumothorax; failure to consider possibility of diaphragmatic penetration in low chest wounds and pericardial tamponade in wounds near midline
Extremity	Lidocaine 1% with epinephrine 1%	3-0 or 4-0 Synthetic absorbable (muscle fascia); 4-0 or 5-0 nonabsorbable monofilament	Single-layered closure is adequate, although layered or running SQ closure may give better cosmetic result; apply splint if wound is over a joint	6–14	Failure to do sensory examination before anesthesia; failure to explore wound visually after hemostasis; unrecognized foreign body left in wound
Hands and feet	Lidocaine 1% (if field block with 2% lidocaine or 0.25% bipivacaine)	4-0 or 5-0 Nonabsorbable monofilament	Single-layered closure only with simple or horizontal mattress interrupted suture, at least 5 mm from cut wound edges; horizontal mattress sutures should be used if much tension on wound edges; apply splint if wound over a joint	7–12	Use of subcuticular sutures; failure to explore wound visually with digit in original position at time of injury
Nailbeds	Lidocaine 2% or bipivacaine 0.25% digital nerve block	5-0 Synthetic absorbable	Gentle, meticulous placement to obtain even edges; stint dressing with original nail or aluminum foil between cuticle and nail matrix to prevent adhesions	Allow to absorb	Loss of suture by tying too tightly and having it cut through friable nailbed suture; adhesions because of failure to place stint between cuticle and matrix

References and Suggested Reading

Trott, Alexander MD. *Wounds and Lacerations – Emergency Care and Closure.* Philadelphia: Mosby, (2005).

Thomsen, Todd MD. (2006) "Basic Laceration Repair" *The New England Journal of Medicine.* Oct. 355:17.