

Wound Management

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Agenda

- Anatomy/Physiology of Wound Healing
- Patient and Wound Assessment
- Decisions prior to repair
- Preparation prior to repair
- Suture Techniques
 - Simple interrupted/Instrument tie
 - Mattress – vertical and horizontal
 - Corner suture
 - Deep suture
- Closure Alternatives
- Post Repair Considerations

Partial

Full

Deep

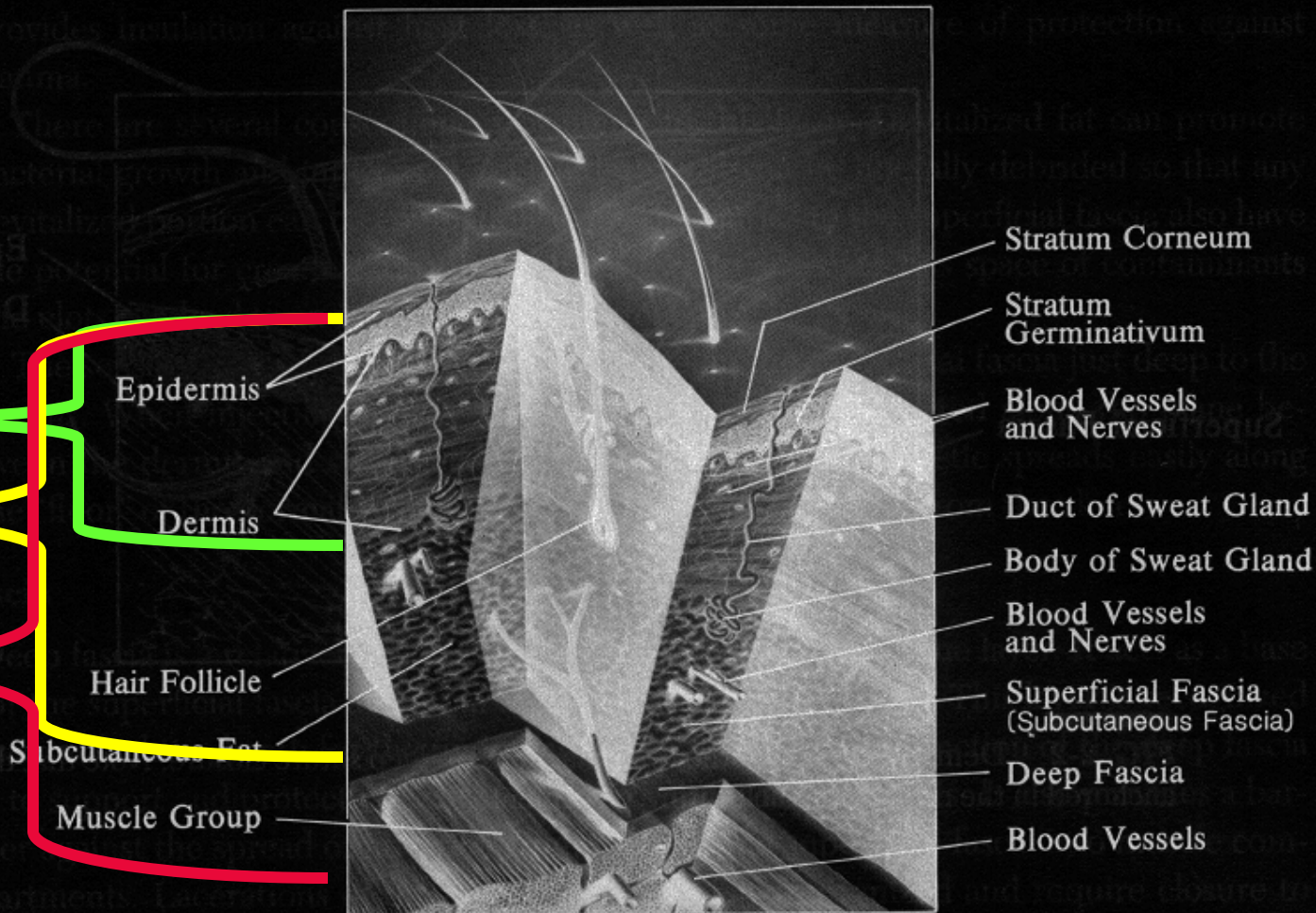
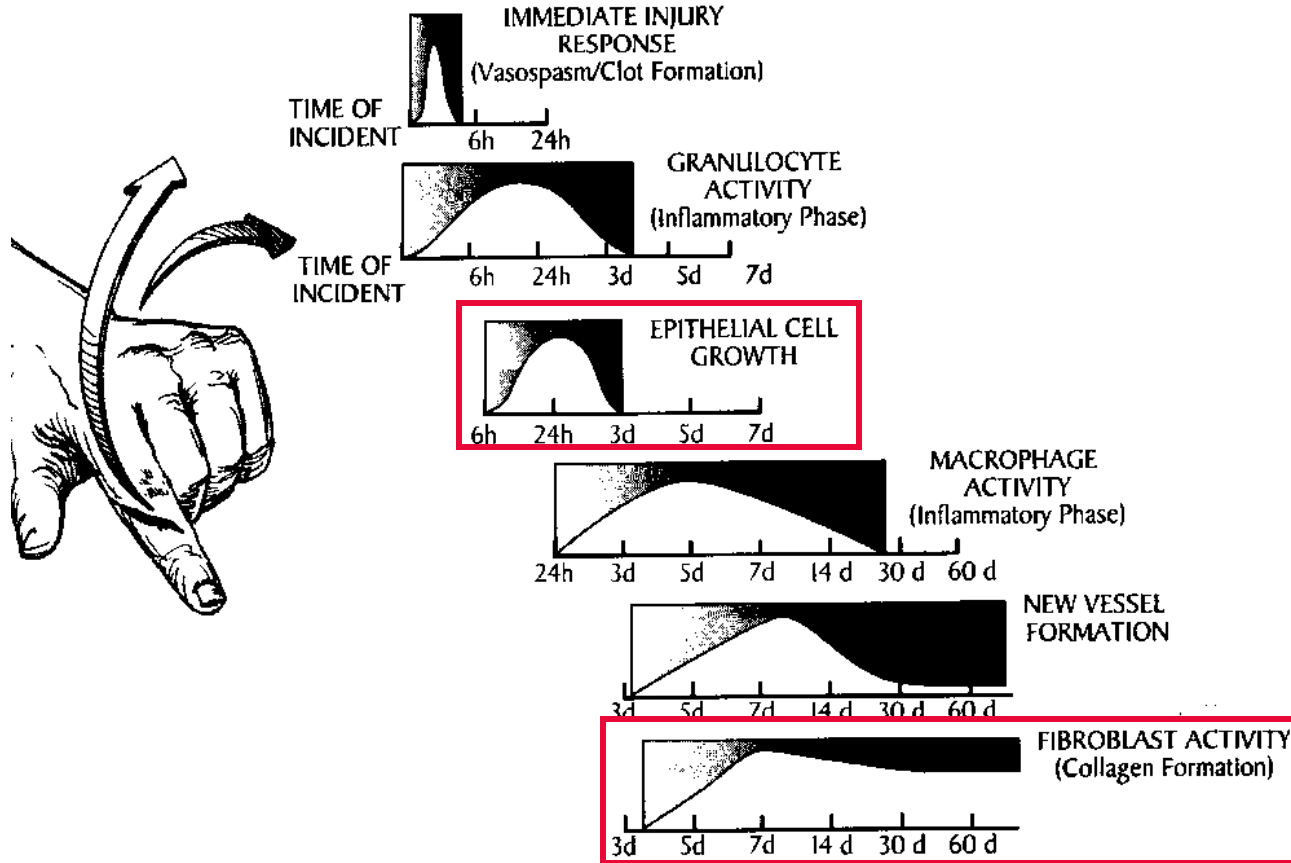


FIG. 2-1 Anatomy of the skin illustrating structures pertinent to wound repair.

Four phases of healing

ACTIVITY OF WOUND HEALING COMPONENTS



Acute
vasospasm/clot

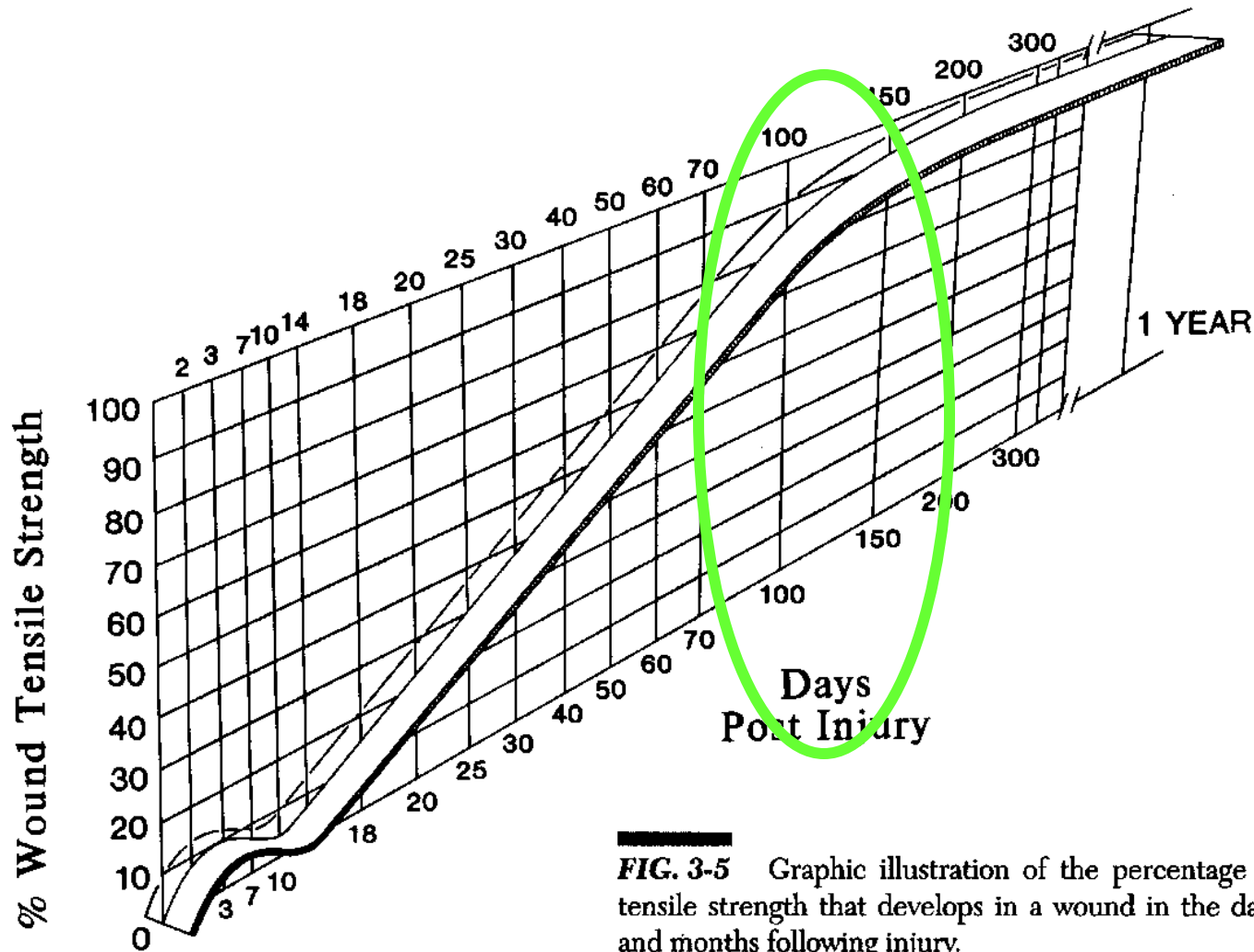
Epithelialization

Inflammation and
ingrowth of
structures

Collagen growth

FIG. 3-4 Graphic illustration of the various components of wound healing and their time frames.

Tensile strength takes 3-4 months to recover



Patient assessment checklist

History

- ✓ Mechanism
- ✓ Age of wound
- ✓ Foreign body?
- ✓ Co-morbidities
- ✓ Tetanus status
- ✓ Allergies

Exam

- ✓ Location
- ✓ Size
- ✓ Depth
- ✓ Neurovascular exam
- ✓ Tendon function
- ✓ Degree of contamination/FB
- ✓ Underlying fracture?

Timing of the repair

- Primary closure
 - Most sites within 6-8h
 - Up to 24hr for face
- Too late, or too contaminated
 - Delayed primary closure if cosmesis is important
 - Secondary intention (wound granulates in)

Risk factors for infection

- 3-6% incidence
- Increased Risk:
 - DM
 - Steroids
 - Foreign body
 - Elderly
 - Larger width/depth
 - Contamination
 - Jagged edges
 - Bites
 - Crush mechanism
 - Edema
- Consider:
 - Xray (open frx)
 - Td status
 - Rabies prophylaxis
 - ?Delayed closure

Animal bites

- Dog – suture face only
 - Infection rate 3-18% (Singer NEJM 2008)
 - Pasturella, Eikenella, staph strep, GNR, anaerobes
 - Onset of infection in 24hours
- Cat – never suture
 - Infection rate 28-80% (Singer NEJM 2008)
 - Pasturella multocida
 - Onset in 12hours
 - Tooth fragments
- Prophylaxis (5d)
 - OR 0.10 [0.01, 0.86] (Medeiros Cochrane 2001)
 - Amox-clav, FQ + clinda, TMP/SMX + clinda
 - **When combined with irrigation, infection rate after primary closure 5.5% in a study of 145 mammalian bites (Chen Acad EM 2001)



Wounds to think twice about

- 20% of closed malpractice claims (Karcz et al, Am J EM 1996)
- Foreign bodies
 - 2nd most common cause for malpractice claims
 - Non-radioopaque FB (including glass)
- Hand lacerations
 - 9th out of the top 10 closed claims (Brown Acad EM 2010)
 - Tendon and nerve involvement may not be obvious!
 - Careful hand examination is critical
- Facial lacerations
 - Nostrils
 - Vermillion border of the lip
 - Eyelids and medial canthus/lacrimal duct
 - Ear with exposed cartilage/hematoma
- Wound with high infection rates
 - Puncture wounds
 - Animal/Human bites (especially the fight bite!)



Preparing the wound for closure

Anesthesia, irrigation, and suture
selection

TABLE 2. PROPERTIES OF COMMONLY USED LOCAL ANESTHETIC AGENTS.*

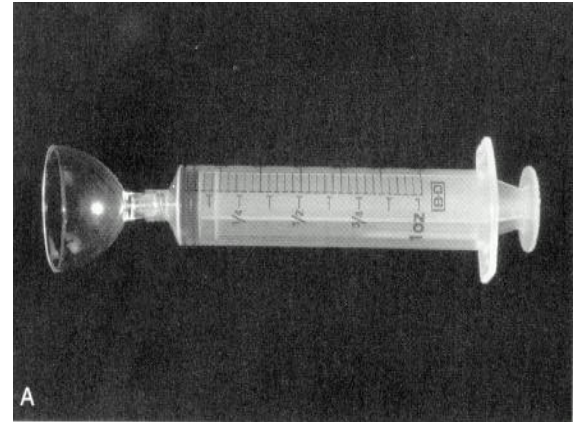
AGENT	TRADE NAME	CLASS	RECOMMENDED CONCENTRATION	MAXIMAL SAFE DOSE	DURATION OF ACTION
			percent	mg/kg	
Procaine with epinephrine	Novocain	Ester	0.5–1.0	7	15–45 min
				9	30–90 min
Lidocaine with epinephrine	Xylocaine	Amide	0.5–2.0	4.5 (30cc)	1–2 hr
				7 (50cc)	2–4 hr
Bupivacaine with epinephrine	Marcaine	Amide	0.125–0.25	2 (70cc)	4–8 hr
				3	8–16 hr

- Local or digital/regional block based on size and anesthetic volume
- Avoid epinephrine on tissue peninsulas
 - Nose, ear, fingers, etc.
- Procaine (amide) can be used for ester-allergic pts

Reducing Pain of Lidocaine Infiltration

- Pretreatment with topical anesthetics
 - LET solution – lidocaine, epinephrine, tetracaine
- Inject through wound margins
- Slow rate of injection
 - Small-bore needles (27G)
- Buffering and warming cuts pain by 40%
(Brogan 1995)
 - Buffer with sodium bicarbonate 8.4% (1:10)
 - Warming the solution
 - Synergistic with buffering (Mader Ann EM 1994)

Irrigation



- High-pressure irrigation: 8-9 psi
 - Reduces wound bacterial counts and wound infection rates
 - Use 30-60 cc syringe with 18-20 gauge catheter or irrigation shield device
 - Tap water is as good as sterile saline! (Bansal Am J EM 2002)
- Volume: 100cc/1cm laceration
- Clean, non-contaminated face/scalp lacerations do not show reduced infection rates after irrigation -- 1% incidence (Hollander Ann EM 1998)

Choosing a suture material

- **Non-absorbable (nylon, prolene) >> absorbable**
(chromic - intraoral)
- Tissue reaction increases scarring
 - Braided >> **monofilament**
 - Absorbable >> **non-absorbable**
- Curved, cutting needle
- Suture size - tensile strength
 - Body – 3.0 or 4.0 (unless very small and intact dermis)
 - Digits – 5.0
 - Hand – 4.0
 - Head and neck – 6.0



Less than 2cm may not need sutures at all!

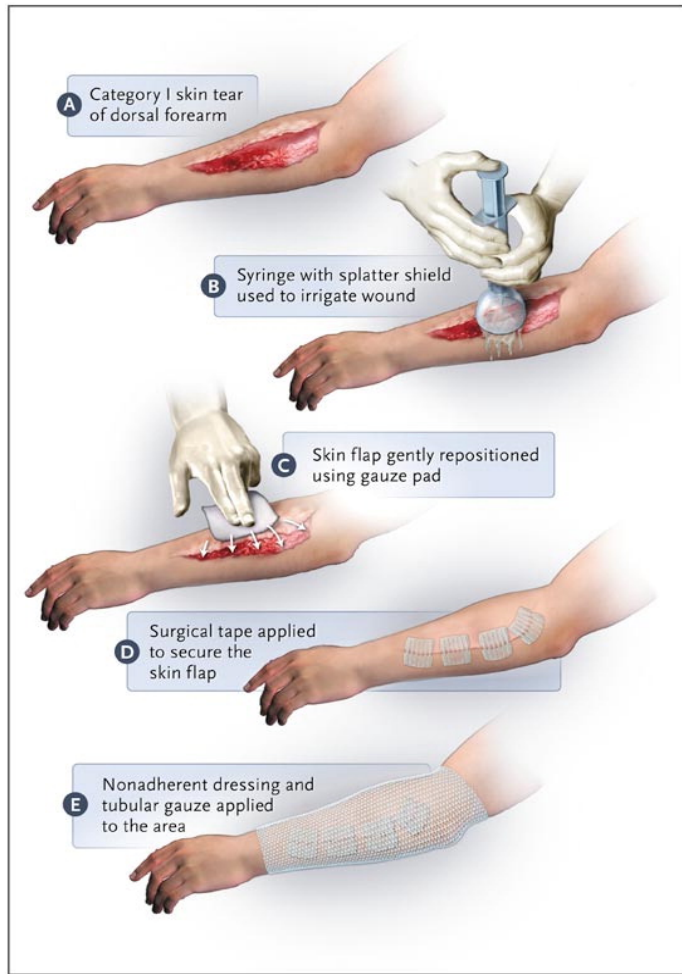
- 95 uncomplicated lacerations of the hand (n=91)
 - full thickness <2 cm
 - no tendon, joint, fracture, or nerve complications
- Randomised to suturing or conservative treatment.
- No difference in
 - cosmetic appearance at 3 months
 - mean time to resume normal activities (3.4 days)
- Conservative management
 - less pain – VAS (100pt) score difference 18mm (12, 24)
 - shorter treatment time – 14min (10, 18)

Alternatives to sutures

- Wound Stapling
- Wound Adhesives (Cyanoacrylate)
 - tensile strength of 4-0 nylon
 - linear, short wounds
 - avoid flexural surfaces and tension wounds
 - no hemorrhage
 - make a bacitracin border to pool the glue
 - remove with petroleum jelly
- Wound Taping
 - Steri-strips (with benzoin)



Skin tear repair using steri-strip approximation



Singer AJ, Dagum AB. N Engl J Med 2008;359:1037-1046.



Sterile Versus Nonsterile Gloves for Repair of Uncomplicated Lacerations in the Emergency Department: A Randomized Controlled Trial

Vsevolod S. Perelman, MD,
MSc
Gregory J. Francis, MD, BSc
Tim Rutledge, MD
John Foote, MD
Frank Martino, MD
George Dranitsaris, MSc(Pharm)

Study objective: Although sterile technique for laceration management continues to be recommended, studies supporting this practice are lacking. Using clean non-sterile gloves rather than individually packaged sterile gloves for uncomplicated wound repair in the emergency department may result in cost and time savings. This study is designed to determine whether the rate of infection after repair of uncomplicated lacerations in immunocompetent patients is comparable using clean nonsterile gloves versus sterile gloves.

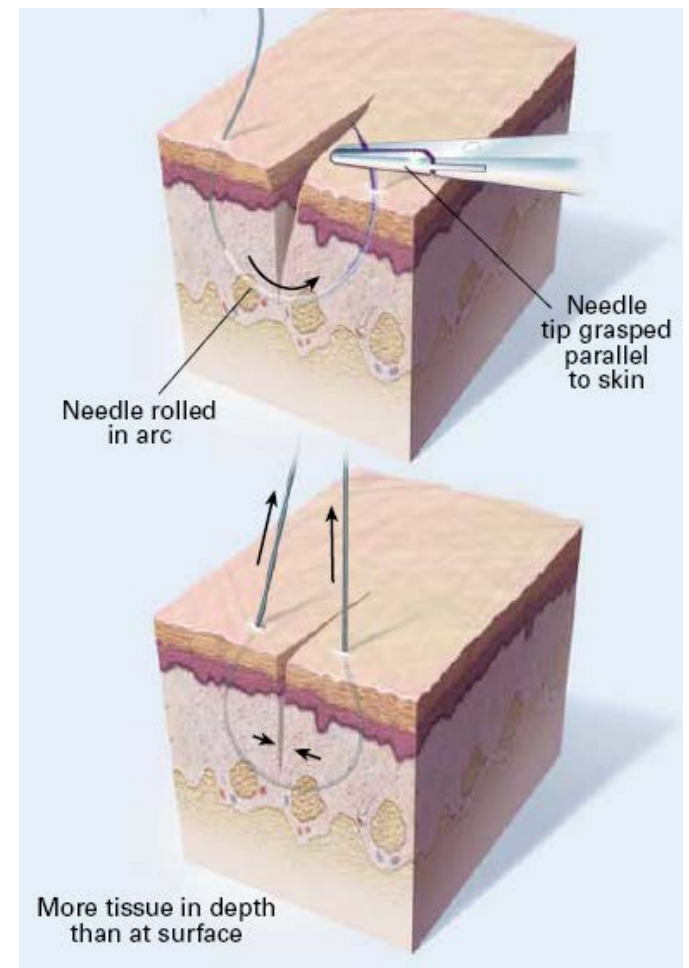
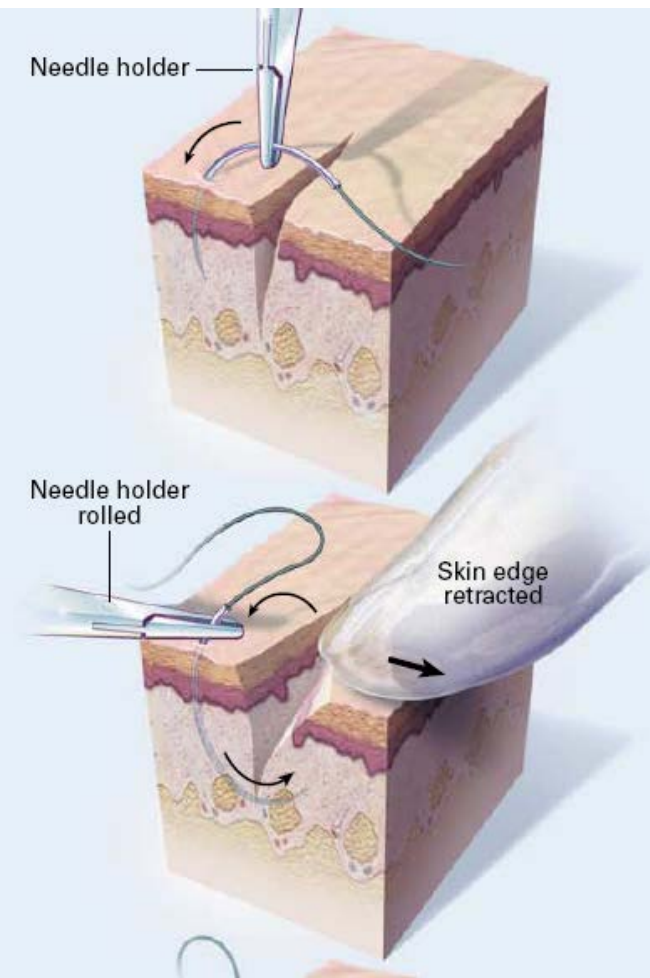
- 816 patients enrolled
- Follow-up: 98% v. 96.6%
- Infection rates
 - Sterile gloves 6.1% (3.8%, 8.4%)
 - Clean gloves 4.4% (2.4%, 6.4%)
 - RR 1.37 (0.75, 2.52)

Closure Techniques

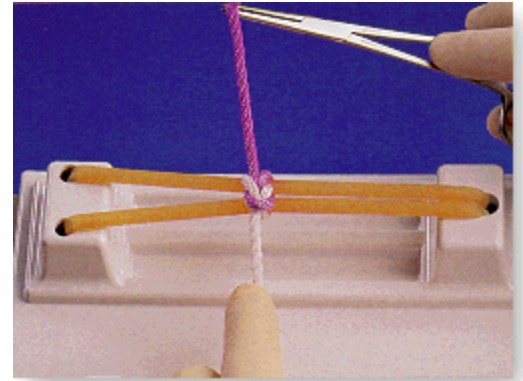
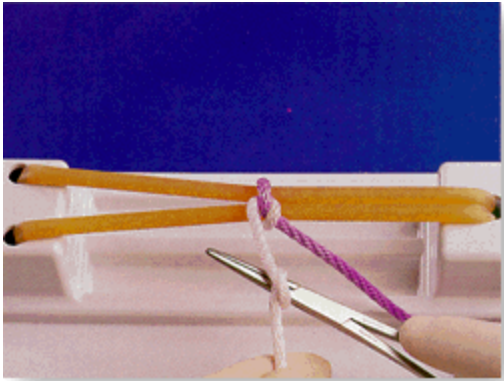
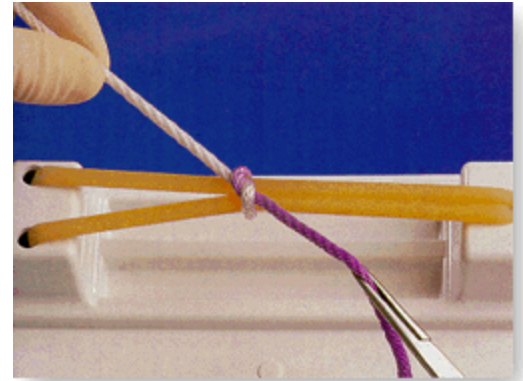
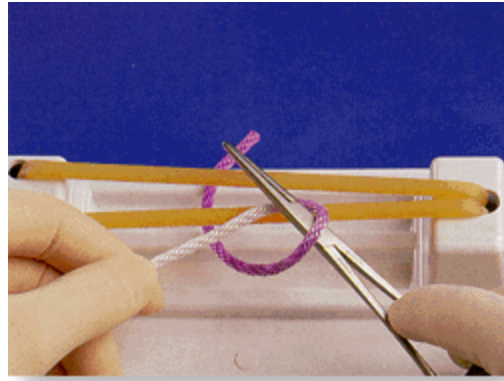
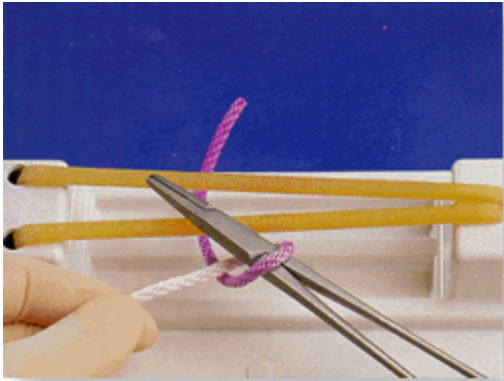
- Take a banana, suture kit, and a packet of suture.
- Practice as we review - ask questions!!!

Simple interrupted (NEJM 1997)

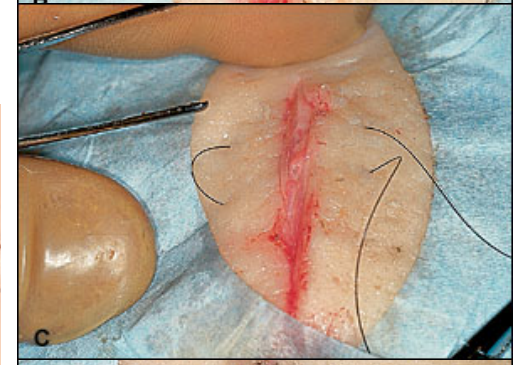
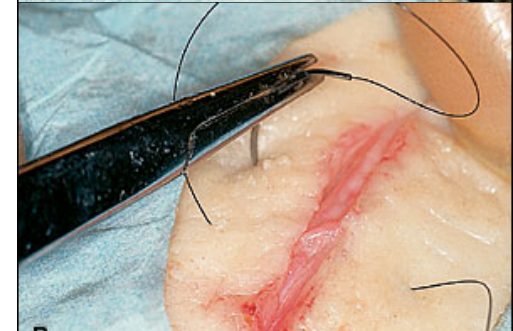
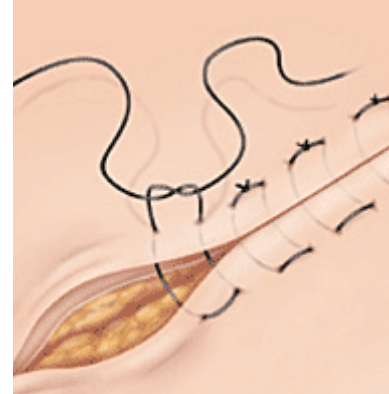
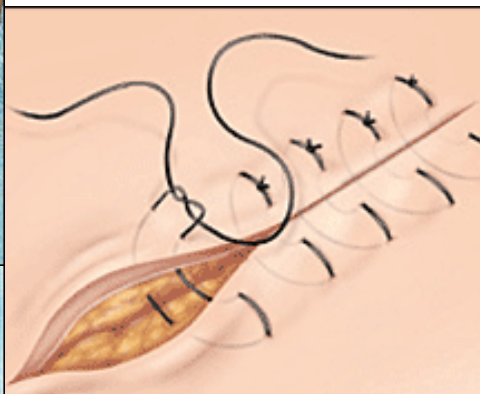
- 90 degree needle introduction ensures eversion/compensates for scar contracture
- Layer matching ensures minimal scar formation/step-off



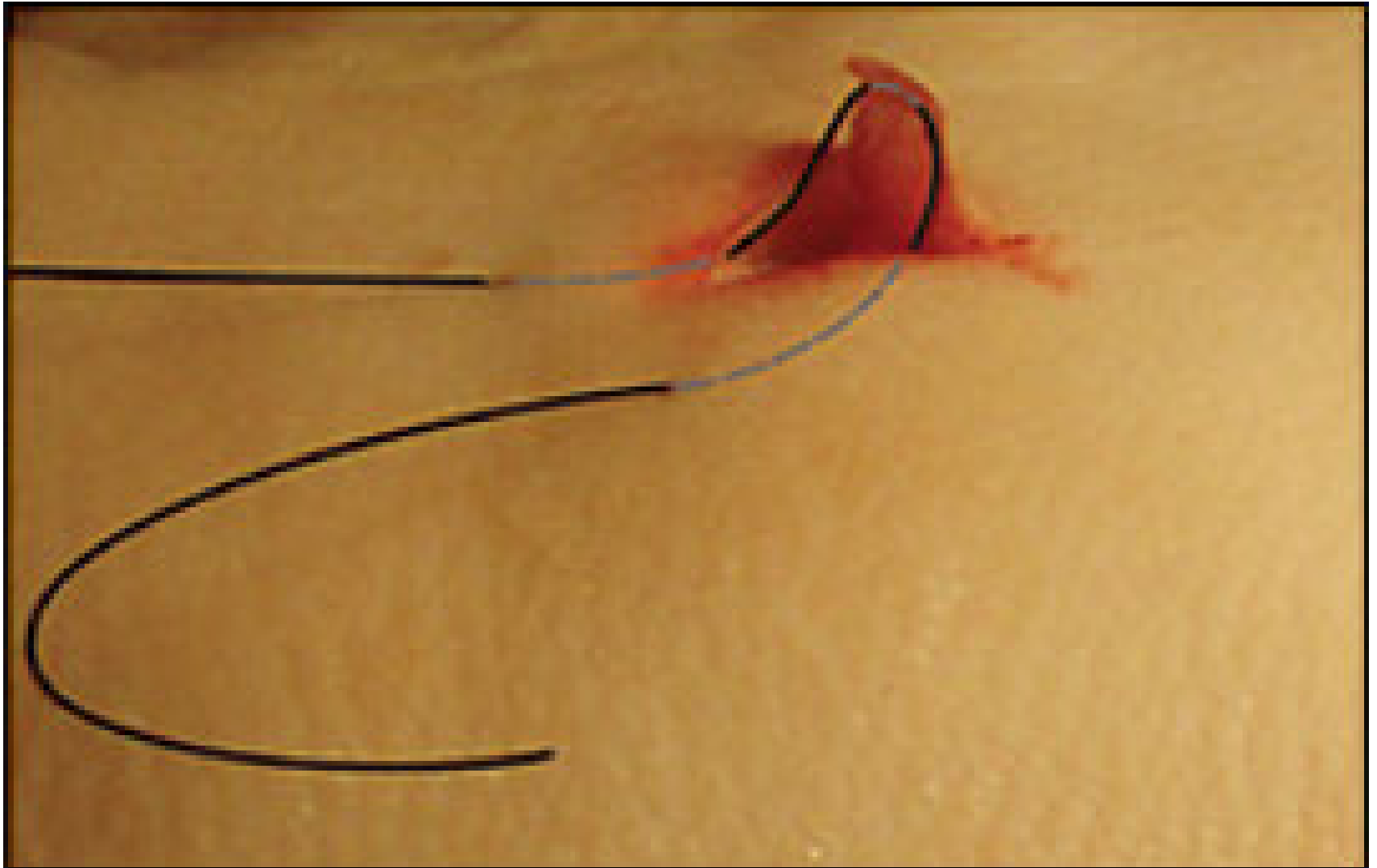
Instrument tie (www.ethicon.com)



Vertical and Horizontal Mattress Sutures



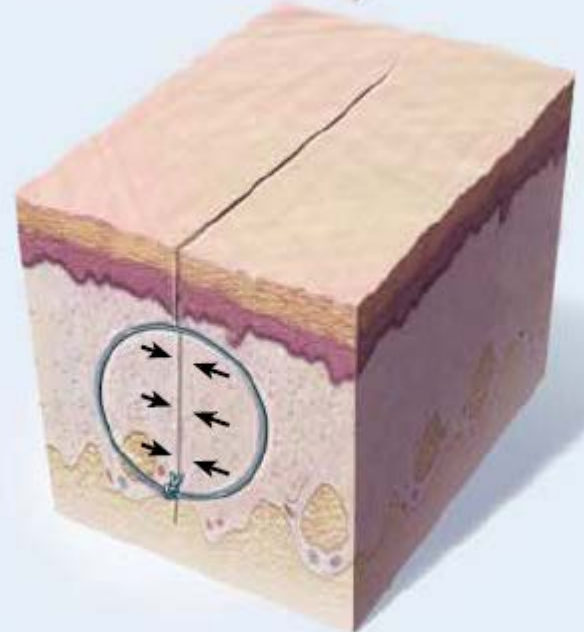
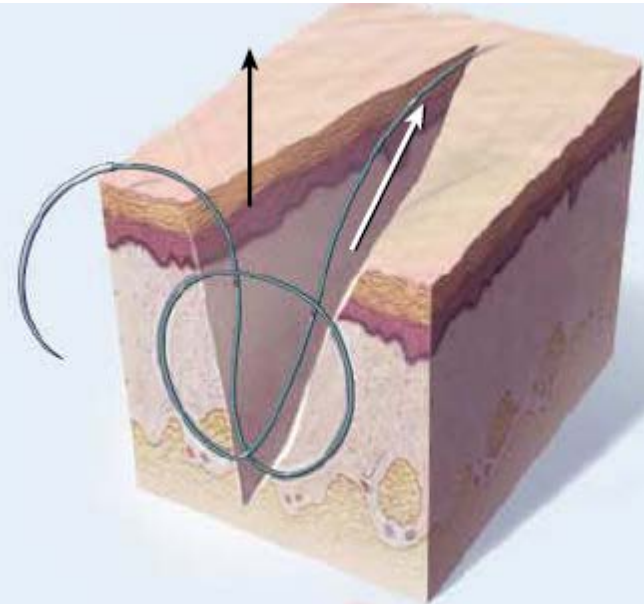
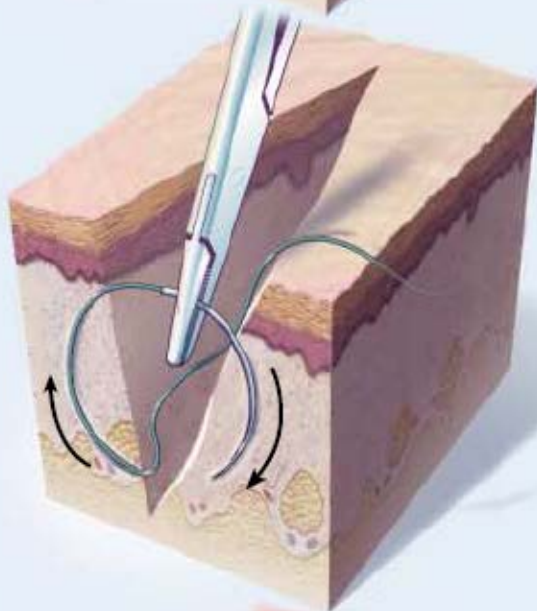
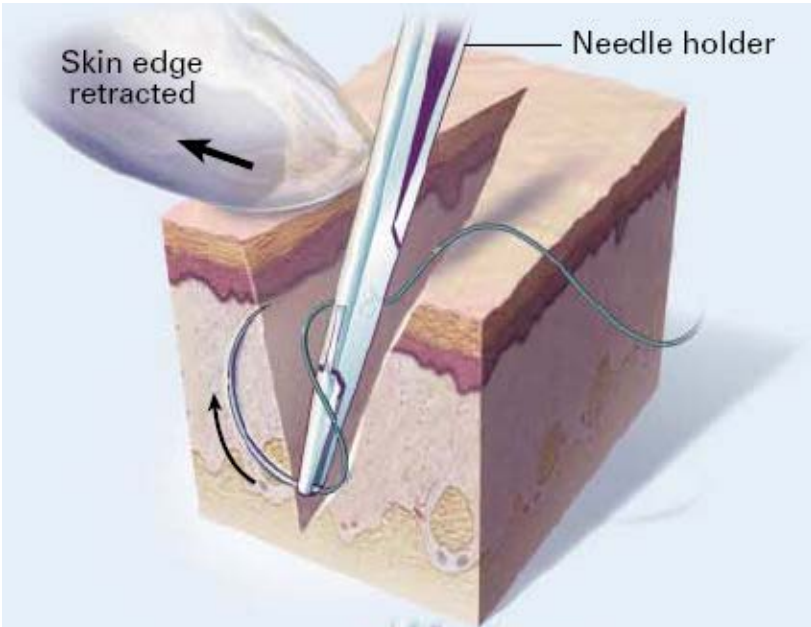
Corner Stitch



Deep Suture

Skin edge retracted

Needle holder



Dressing the wound

- Pull knots to side (dec. FB reaction/ease removal)
- Apply firm pressure (30sec) to closure to aid coagulation and decrease edema
 - Educate patient on risks infx/retained FB/scarring
- Bacitracin to the suture line
- Dry dressing taped/tegadermed in place

Follow-up

- Wound instructions
 - Dressing X 24-48 hrs until epithelialization
 - Topical bacitracin (no polymixin B!)
 - UV protection: sunscreen after suture removal
 - Scar formation takes 4-6 months to complete
- Suture removal timing
 - Risk of suture scars “railroad tracks” >7-14d
 - Wound tape may remain for 10d

Suture removal in...

Location	Days
Face/ear	4-5
Scalp	6-8
Trunk/arm/leg	8-10
Finger/extremity flexural surface	10-12
Back/foot	12-14

Critical summary points

- Document a careful history and exam (esp. hands)
- Assess for foreign body by feel and film
- Use high pressure irrigation to reduce infection
- Choose suture techniques that minimize wound tension
- Set expectations for FB, scarring, and infection

*For a great review of laceration
repair, go to NEJM online*

[http://content.nejm.org/cgi/video/3
55/17/e18/](http://content.nejm.org/cgi/video/355/17/e18/)

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