



Wound Management and Suturing Skills for the Nurse Practitioner

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Disclosure Slide

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- ▶ Johnson & Johnson: Ethicon, *Wound Closure Manual*
- ▶ <https://www.sutureonline.com/wound-closure-manual>
- ▶ Free download, Chapter Two is all about suturing

Objectives

Upon completion of this session, the participant should be able to:

1. List the three major classification of wound healing
2. Describe the elements of sterile field preparation, maintenance, wound preparation and management.
3. Outline the use of various local anesthesia and recommendations for Tetanus prophylaxis.
4. Describe methods to maintain homeostasis of the wound including: Direct pressure, gravity, vasoconstrictive agents, suture ligation and safe tourniquet application.

Objectives

Upon completion of this session, the participant should be able to:

5. Describe suture/needle selection and size for various types of wounds including silk, nylon/prolene, gut/dissolvable.
6. Demonstrate the following types of suturing and describe their use: simple interrupted, running, mattress: horizontal and vertical, figure of eight, subcuticular with and without Aberdeen knot placement, and chest tube/device suture securing options.
7. Describe the selection and use of antibiotic therapy for various types of wounds: dirty, animal and human bites prophylaxis resistant strains

ICD 10

- ▶ Use the code OHQ to indicate repair
- ▶ The area impacted is applied and there are many. Some examples

Site/Skin	Code
Scalp	OHQ0
Face	OHQ1
Right Upper Arm	OHQB
Left Upper Arm	OHQE
Abdomen	OHQ7
Right Lower Leg	OHQK
Left Lower Leg	OHQL

Laceration repair Trunk, Extremity, scalp and neck

CPT code	Medicare	Conventional	Hospital
12001 to 2.5cm	\$149.31	\$116.23	\$181
12002 2.6-7.5 cm	\$158.77	\$159.75	\$233.00
12004 7.6-12.5 cm	\$186.12	\$194.65	\$274.00
12005 12.6-20.0 cm	\$232.15	\$263.08	\$342.00

Laceration repair Face, Ear, Eye, Nose, Genitalia

CPT code	Medicare	Conventional	Hospital
12011 to 2.5 cm	\$157.87	\$210.66	\$217
12013 2.6- 5.0 cm	\$173.09	\$261.90	\$248
12014 5.1- 7.5 cm	\$204.68	u/a	\$296
12015 7.6- 12.5 cm	\$257.74	u/a	\$435
12016 12.6-20 cm	\$305.93	u/a	\$461

Four Classification of Wounds

- ▶ Based on estimation of microbial contamination and risk of infection:
 - ▶ Clean - surgical
 - ▶ Clean-contaminated - usually surgical, such appendicitis
 - ▶ Contaminated - related to trauma
 - ▶ Dirty and Infected contaminated - abscesses, FB contamination, surgical wounds that become infected.

Four Major Types of wounds

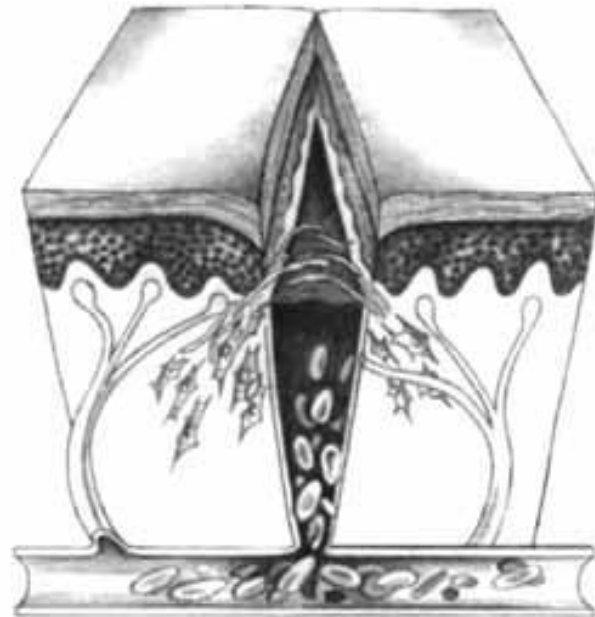
- ▶ Blunt= stab with a dull object
- ▶ Sharp= stab with a sharp object
- ▶ Foreign Bodies
- ▶ Bites
- ▶ Can further be defined as avulsion (partial, complete), abrasion or deep

Wound healing

- ▶ Primary right away
- ▶ Secondary intent (inside out)
- ▶ Delayed Primary. Closed after some granulation of wound margins

Tissue response to injury phase 1

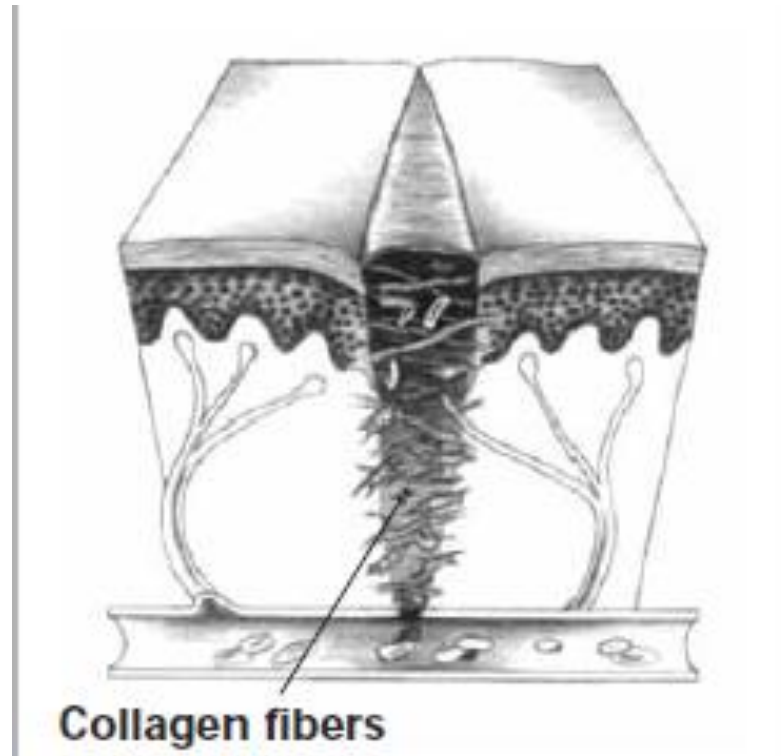
Day 1-5 inflammatory response



Increased Blood Supply

Phase 2 migration/proliferation

► Day 5-14

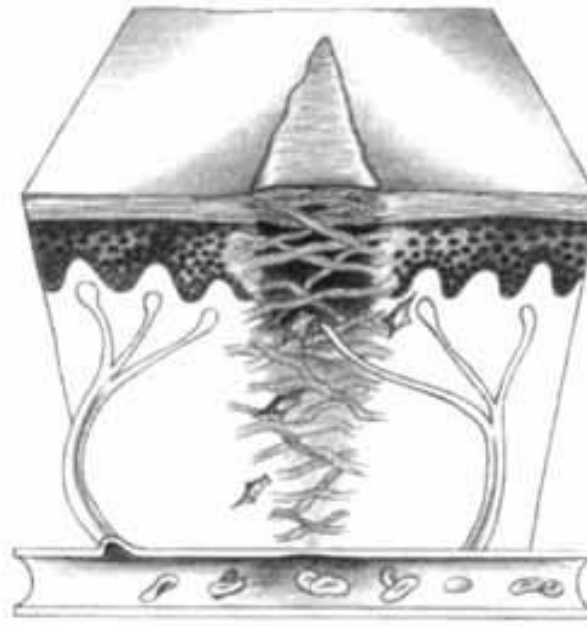


Collagen fibers

Collagen (Scar) Formation

Phase 3 Maturation/Remodeling

- ▶ 14 days to 1 year/protect from s

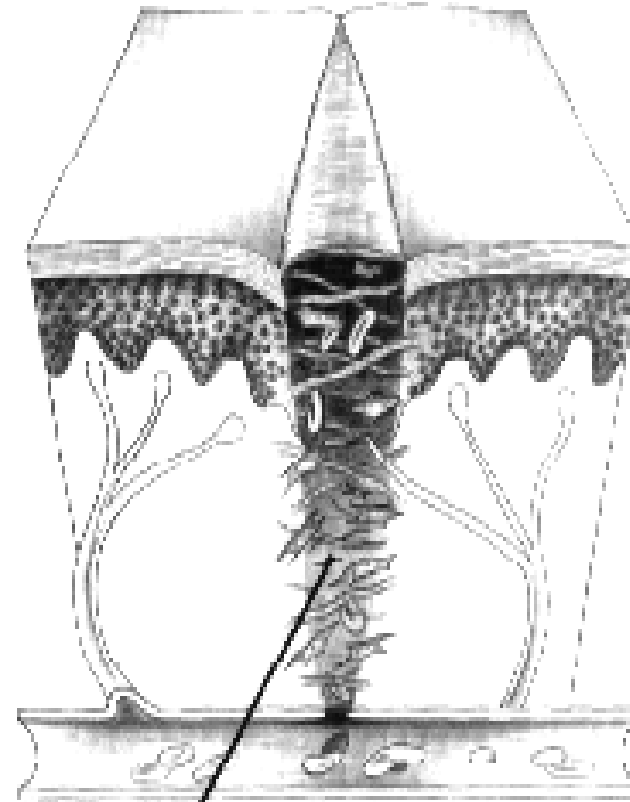


Enough Collagen Formed

Phase III Wound Healing

▶ Maturation/Remodeling:

- ▶ Collagen formation is necessary to restore tensile strength to the wound
- ▶ This process begins within 48 hours of injury and peaks in the first week
- ▶ Progressive increase in tensile strength
 - ▶ By 2 weeks wound has healed to 20% of its pre-wound strength
 - ▶ By 5 weeks it has healed to 50%
 - ▶ By 10 weeks it has healed to 80%
 - ▶ Remodeling and maturation of the scar continues for one year or longer



Collagen fibers

Photos from
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Rules for wound closure

- ▶ Do not do a primary closure on dirty wounds
- ▶ Do not close wound on extremities or trunk over 12 hours
- ▶ Do not close wounds on face over 24 hours old
- ▶ Bites - should always avoid closure, if possible
 - ▶ If mammal, place on antibiotics
 - ▶ Augmentin is first line

Factors Affecting Wound Healing

- ▶ **Comorbid conditions:**
 - ▶ DM
 - ▶ Renal insufficiency
 - ▶ Disorders of collagen synthesis (Ehler-Danlos/Marfan's Syndromes)
 - ▶ Immunocompromise
 - ▶ Nutrition
 - ▶ Obesity
 - ▶ Medications (chemotherapy, corticosteroids, biologics, anticoagulant & antiplatelet drugs)
 - ▶ Smoking and alcoholism
- ▶ **Temperature** (the higher the temperature of the anatomic area, the greater the blood supply)
- ▶ **Blood supply** (the better the blood supply the more oxygen to the injured tissues improving rate of healing)
- ▶ **Ischemia**
- ▶ **Infection**

Wound cleaning

- ▶ Normal Saline is the best
- ▶ Betadine is out
- ▶ Hibiclens is questionable
- ▶ Peroxide and alcohol products tend to do more tissue damage.
- ▶ Shaving is always bad
- ▶ Golden rule Clean and irrigate with pressure!!!!!!!

Principles of Wound Closure

▶ **Assessment of wounds/lacerations:**

- ▶ Determine mechanism of injury
- ▶ Age of injury
- ▶ Possible contamination/foreign body
- ▶ Extent of the wound
- ▶ Neurovascular compromise or tendon injury
- ▶ Need for tetanus prophylaxis
- ▶ Identify risk factors that affect healing

▶ **Goals of wound closure/healing:**

- ▶ No infection
- ▶ Return of normal function
- ▶ Excellent cosmetic result

Location of injury

- ▶ Where is it and will it be moving
- ▶ General health status of patient



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Foreign bodies

- ▶ Is it suspected
- ▶ If so x-ray
 - ▶ Note: Not everything shows up
 - ▶ Wood/Plastic
- ▶ Always x-ray if glass is involved or if source is not known
- ▶ Remove FB that can be easily found.
- ▶ Those that are deep or difficult to find should be closed/referred with the patient aware of situation



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Tetanus Status

- ▶ Always ask tetanus status
 - ▶ “I don’t know” = today
- ▶ Update anyone over the age of 7 who has not been updated in 5 years



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Local Anesthesia

▶ Topical Agents

- ▶ Expensive
- ▶ Limited usefulness (primarily for children & insertion of IV catheters)
- ▶ Longer time to onset of action

▶ Injectable Agents

- ▶ Local infiltration with an injectable agent is preferable for surgery on intact skin, large wounds and when immediate anesthetic effect is required
- ▶ Relatively quick onset of action (2-10 minutes) depending on agent
- ▶ Duration of action 30 minutes to 6 hours depending on agent
- ▶ Generally administered as an intradermal or subcutaneous injection blocking pain transmission from the free nerve endings in the epidermis and dermis; intradermal injection is more painful
- ▶ Most injectable agents are weak bases with a pKa of 8-9 any physiologic acid with potentially neutralize the local reducing or eliminating effect or duration of action. The non-ionized portion of the local is what cause the block

Local Anesthesia/Injectable Agents

- ▶ **Amides**
 - ▶ Lidocaine (most commonly used agent)
 - ▶ Mepivacaine
 - ▶ Bupivacaine/Marcaine
- ▶ **Esters**
 - ▶ Procaine/Novocaine
 - ▶ Tetracaine
 - ▶ Cocaine
 - ▶ Benzocaine
- ▶ **Alternatives (hx of allergy to “caine” drugs)**
 - ▶ Injectable diphenhydramine (DPH) 1% solution (10mg/mL)
 - ▶ Benzyl alcohol
 - ▶ Normal saline

Local Anesthetic

- ▶ Make it as painless as possible
- ▶ Inject through wound edges not directly into skin
- ▶ Can buffer 10cc of local with 1 cc of NaHCO_3
- ▶ Can warm in your pocket (the bottle)

Typical Topical Anesthetics

- ▶ Most common local are amides and are alkaline
- ▶ Effect depends on amount of acid in the tissue. PKA is decreased in acid environment
- ▶ No cross reaction or sensitivity in the group (most are allergic to the preservative methylparaben)
- ▶ Lidocaine allergy does not mean marcaine allergy

Lidocaine bupivacaine

- ▶ Lidocaine 1% or 2%
 - ▶ 1% most commonly used
 - ▶ Toxic is above 5 mg/kg
 - ▶ 1% = 10 mg/ml
 - ▶ 5 ml = 50 mg
 - ▶ Toxic dose for a 10 kg child
 - ▶ 2% = 20 mg/ml
 - ▶ 5 ml = 100 mg
 - Bupivacaine 0.25-0.5 %
 - ▶ 0.25% commonly used
 - ▶ AKA: Marcaine; Sensorcain

Lidocaine/bupivacaine

▶ Lidocaine

- ▶ Onset fast, 2-5 min
- ▶ Max does 5mg/Kg
- ▶ Max with epi 7mg/Kg
- ▶ Allergy rare, dizziness, tinnitus, metal taste, seizure coma, ↓ BP, ↓ HR death

▶ Bupivacaine

- ▶ Onset slower 5-10 min
- ▶ Max does 2mg/Kg
- ▶ Max with epi 3mg/kg
- ▶ IV injection can cause refractory asystole.

Injectable Agents Additives

▶ Sodium Bicarbonate

- ▶ Buffers the acidic pH of injectable agents decreasing pain at the injection site
- ▶ Lidocaine (with or w/o epi): add 1 mL (1mEq/mL) bicarbonate to 9 mL lidocaine before injection
- ▶ Bupivacaine (with or w/o epi): add 1 mL of bicarbonate to 19 mL bupivacaine before injection; less likely to reduce pain of injection when compared to lidocaine

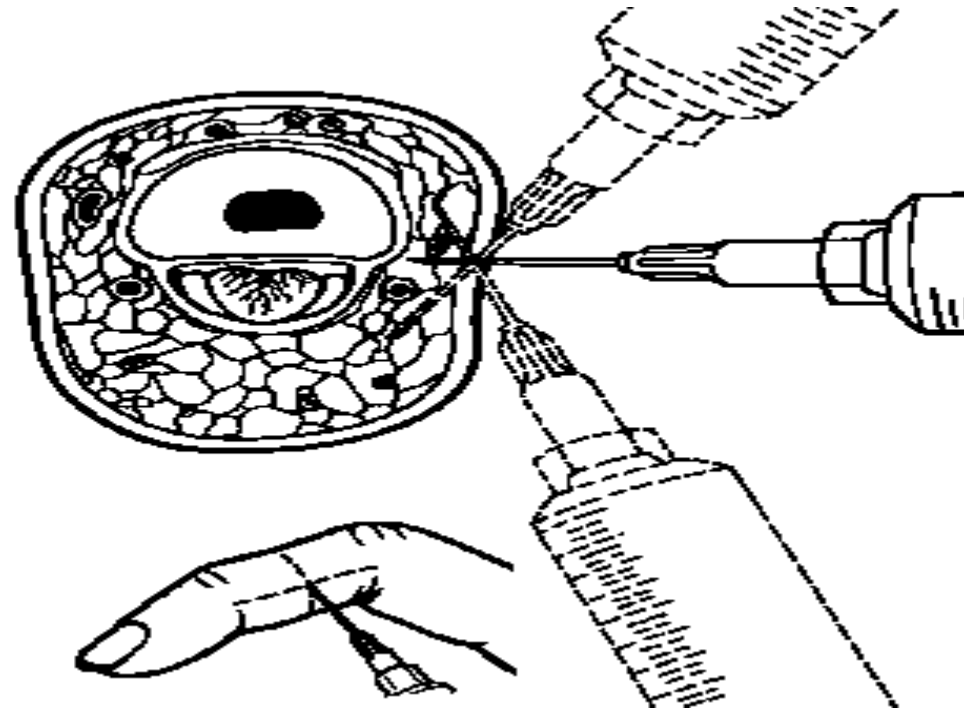
▶ Epinephrine

- ▶ Causes local vasoconstriction decreasing bleeding during the procedure
- ▶ Prolongs anesthetic agents duration of action (except for bupivacaine)
- ▶ Decreases systemic absorption of the anesthetic agent
- ▶ Contraindications:
 - ▶ Prior allergic reaction/catecholamine sensitivity (tachycardia, HTN, palpitations, anxiety)
 - ▶ Digital anesthesia in patient with PAD
 - ▶ Wounds with irregular or ragged skin edges with circulatory compromise
 - ▶ Can be used in the face, nose, ears, digits or penis; no convincing evidence in medical literature or studies to support harm with such use
 - ▶ Pregnancy Category C

Word on use of Epinephrine

- ▶ Be careful
- ▶ Increase risk for infection
- ▶ Takes about 10 min. to help control bleeding
- ▶ Prolongs the effects of locals
- ▶ Distal Circulation sites:
 - ▶ Fingers, toes, tip of nose, ears, or penis
 - ▶ The myth
 - ▶ A myth disproved by multiple studies
 - ▶ *Plast. Reconstr. Surg.* 2010;126:2031-4
 - ▶ *J. Eur. Acad. Dermatol. Venereol.* 2014 [doi:10.1111/jdv.12746]

Digital blocks



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Methods of Closure

▶ Sutures

- ▶ Absorbable
 - ▶ Synthetic
 - ▶ Animal
- ▶ Non-absorbable
 - ▶ Synthetic
 - ▶ Biological

▶ Staples

- ▶ Good for hidden wounds
 - ▶ Tends to produce more of a scar
 - ▶ Excellent for scalp
 - ▶ Be sure to get CT, if needed, prior

▶ Glue

- ▶ Good for superficial closure
- ▶ Non-flexible area (no bends or wrinkles)
- ▶ Do not use in or near hair
- ▶ Do not use petroleum based products near the glue

▶ Steri Strips

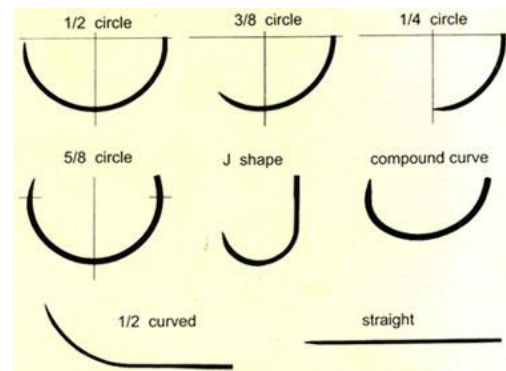
- ▶ Superficial closure only
- ▶ Must be kept fairly dry
- ▶ Increased utility in elderly with friable skin

Suture Material

- ▶ Absorbable
 - ▶ Gut last 3-4 days
 - ▶ Chromic gut 7-10 days
 - ▶ Vicryl/Ethicon up to 14 days (least reaction)
- ▶ Non-Absorbable
 - ▶ Nylon (Ethilon/Prolene) synthetic less reaction harder to tie
 - ▶ Silk. Biologic and braided, so increased risk of infection.

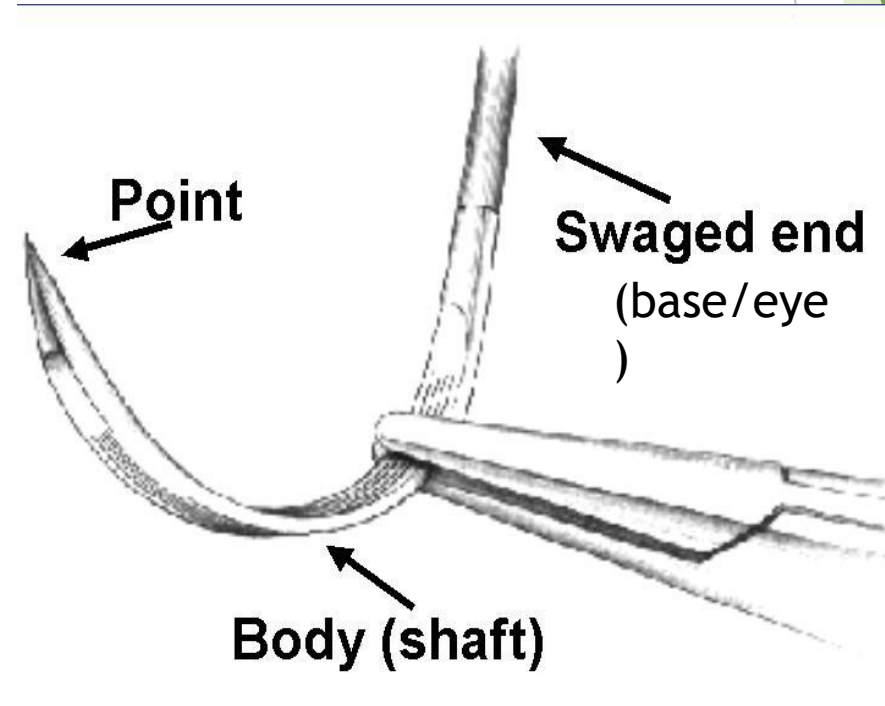
Needle types

- ▶ Straight
 - ▶ Not used to close lacerations
- ▶ Curved straight needle
 - ▶ Curved end
 - ▶ Not used to close lacerations
- ▶ Circle $\frac{1}{4}$ to $\frac{5}{8}$
 - ▶ Normally use $\frac{3}{8}$ to $\frac{1}{2}$
- ▶ Two types of circle needles
 - ▶ FS
 - ▶ For skin
 - ▶ Does not last long as
 - ▶ P or PS
 - ▶ Plastics quality needle
 - ▶ Lasts longer than FS needle



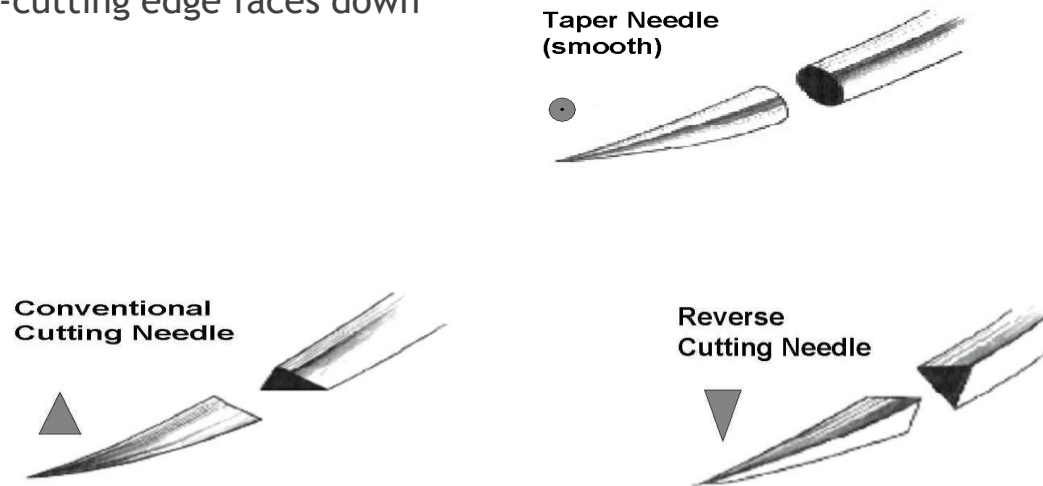
Needles

- ▶ Many different needle types to choose from:
 - ▶ Curved vs. Straight
 - ▶ Curvature: 1/4, 3/8, 1/2 or 5/8 circle; most common 3/8
 - ▶ FS/CE series: standard skin needles for scalp, trunk, or extremities; used on thick skin
 - ▶ (FS-for skin; CE-cutting needles)
 - ▶ P/PS/PC/PRE series: smaller/sharper needles for face & delicate areas; used for cosmetic closures
 - ▶ (P-plastic; PS-plastic skin; PC-precision cosmetic; PRE-premium)



Needles Continued

- ▶ Taper/smooth vs. Cutting
 - ▶ Taper/smooth needles are primarily used for tissues that are easy to penetrate (bowel or blood vessels); rounded shaft that gradually tapers to a point
 - ▶ Cutting needles have a triangular shaft and tip forming a cutting surface used for tissues that are tough to penetrate (skin); conventional-cutting edge faces up; reverse-cutting edge faces down



Suture Sizes

*The smaller the suture the more knots you have to throw

Needle	Size of Thread	Size of Needle	Site of Use
6-0	Very Thin	Very Small	Face
5-0	Thin	Small	Hands and Fingers
4-0	Medium Thickness	Medium	Arms/Legs, Finger/Toe Joints
3-0	Medium/Thick	Medium/Large	Backs, Thighs, Legs, Joints of Knees and Elbows
2-0	Thick	Large	Central Lines/ Chest tubes
1-0	Very Thick	Very Large	Rarely used, Greatest risk for scars



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Knots

- ▶ It takes practice to throw knots
 - ▶ At least 5 knots for nylon type of suture
 - ▶ Need more for thinner suture material



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When to Remove Sutures

Location	Days to Removal
Face	3 - 5
Scalp	7 - 10
Arms	7 - 10
Trunk and Legs	10 - 14
Hands and Feet	10 - 14
Palms and Soles	14 - 21
Joints	14 Consider Splinting

After suture removal, consider Tincture of Benzoin and Steri-Strips for added tensile strength

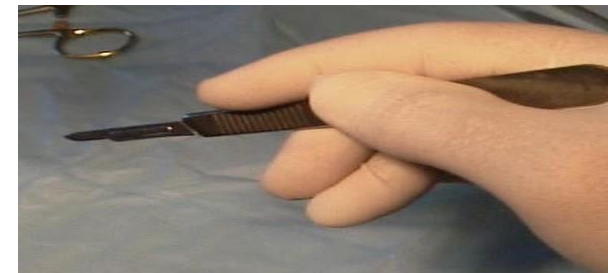
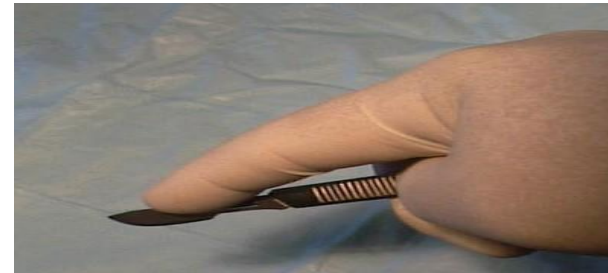
Suture Removal

- ▶ Face: 3-5 days
- ▶ Neck: 7 days
- ▶ Scalp, chest, abdomen, arms: 7-10 days
- ▶ Back, legs, feet: 10-14 days; up to 20 days in some cases
 - ▶ Rate of healing can be affected by co-morbid conditions and the amount of tension on the wound. Take these factors into account when determining if sutures should be left in for a shorter or longer period of time.
 - ▶ Clean skin with alcohol swab or saline prior to suture removal to remove any crusting.
 - ▶ Gently lift the knot away from the surface of the skin and only cut on one side of the knot.
 - ▶ Gently remove suture by pulling the cut stitch across the surface of the wound instead of away from the wound.

Instruments Needed

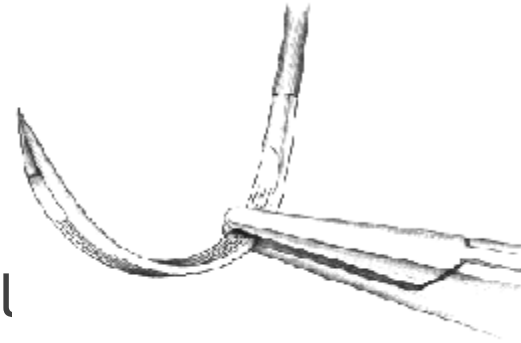
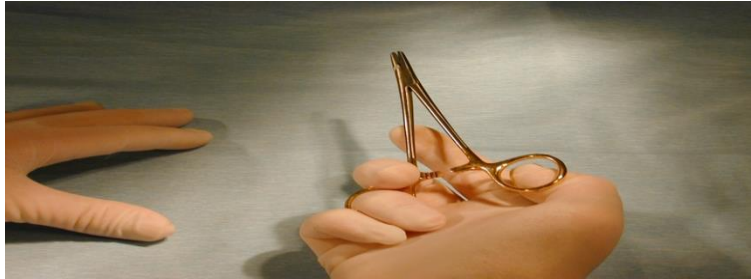
▶ Scalpel

- ▶ The most commonly used blades are the #10, #11 & #15
 - ▶ #10 is better for long, straight incisions
 - ▶ #11 is better for stab incisions (I&D) and precision cutting
 - ▶ #15 is better for short, tortuous incisions



Instruments Needed

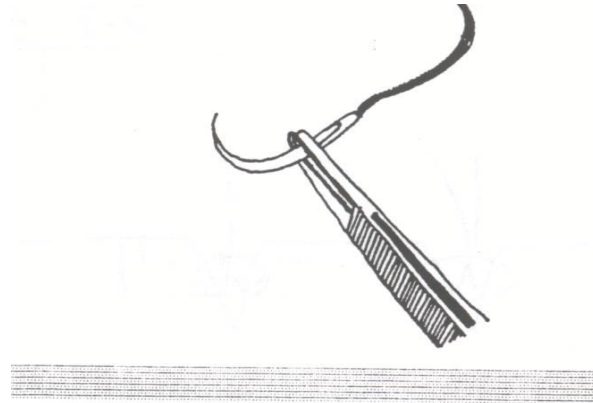
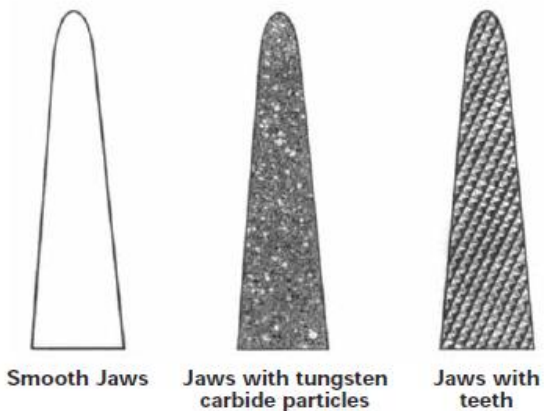
- ▶ Needle Holder/Driver



- ▶ Place your thumb & ring finger sl into the instrument's rings.
- ▶ A second technique is grasping the rings and body of the needle holder in the palm of your hand w/o placing your fingers in the rings.
- ▶ Grab the needle with the driver 1/2 to 2/3 back from the tip of the needle; you will hear a click when the clasp is engaged.

What do I do

- ▶ Needle holder “Driver”
- ▶ Goal is to not touch skin.
- ▶ Only probe with curved objects
- ▶ Forceps best to use toothed kind to evert skin. Flat only crushes tissue
- ▶ Iris scissors delicate scissors used for wound debridment.



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General rules

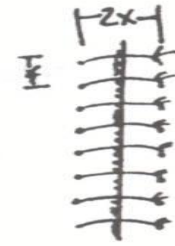
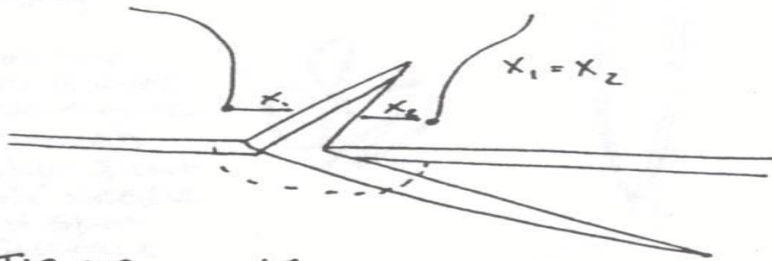
- ▶ Everted wound edges and enter at 90 degrees
- ▶ Aligned tissue layer
- ▶ Do not tie suture too tight, just approximate the edges
- ▶ Make it symmetric
- ▶ Do not over or under approximate
- ▶ Big bites (depending on site)

Pointers

- ▶ Line up anatomic lines first
 - ▶ Palms line up creases first
 - ▶ Lip line up vermillion border first
- ▶ Wrist Lacerations
 - ▶ Make sure it was not an attempted suicide
- ▶ Control bleeding with tourniquet
 - ▶ Especially Fingers and Toes
 - ▶ No longer than 20 min.
- ▶ Dressing
 - ▶ Make it look good
 - ▶ Clean and dry
- ▶ May use antibiotic ointment.
 - ▶ Face and Scalp for 24 hours
 - ▶ > 24 hours → Increased scar formation
- ▶ Protect from sun
 - ▶ 6 - 12 months
 - ▶ Sunscreen, hat, Band-Aid

Skin entry

This is it



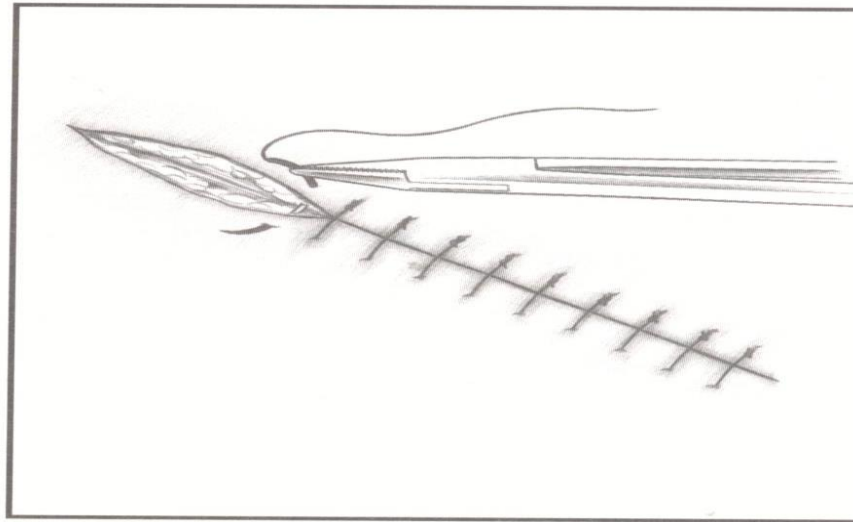
Major types of suturing

- ▶ Continuous
 - ▶ Can be external or buried increased risk of infection and scarring
- ▶ Interrupted
 - ▶ Most useful
 - ▶ Can be external or buried

Interrupted Sutures

Simple interrupted

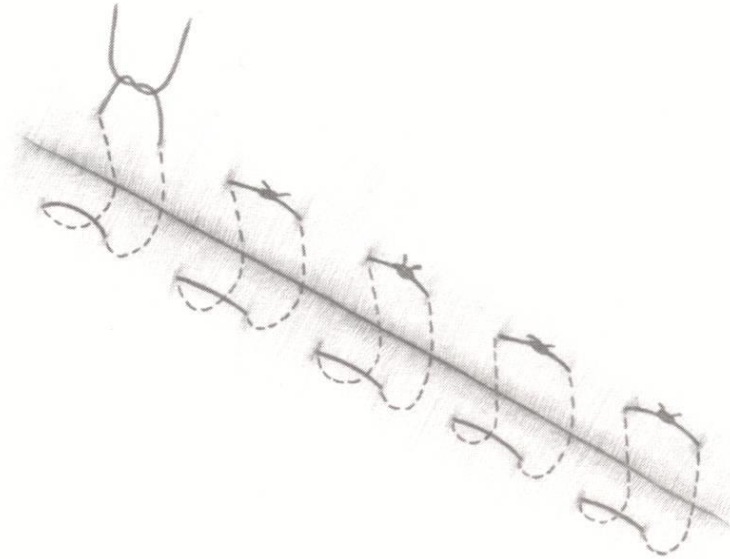
- ▶ Most common and useful
- ▶ Should always be used over running
- ▶ Each Bite should be $\frac{1}{2}$ the depth of the dermis.



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Horizontal mattress

- ▶ Good for distributing wound tension over a greater area
- ▶ Good for palms, soles
lower extremities



Vertical mattress

- ▶ Contrary to belief does not reduce wound tension
- ▶ It everts wound edges
- ▶ Useful in loose or flabby skin (back or arm)
- ▶ Size and placement is the same
- ▶ 1st entry is $\frac{1}{2}$ depth of dermis
- ▶ 2nd should be “3 cells thick”

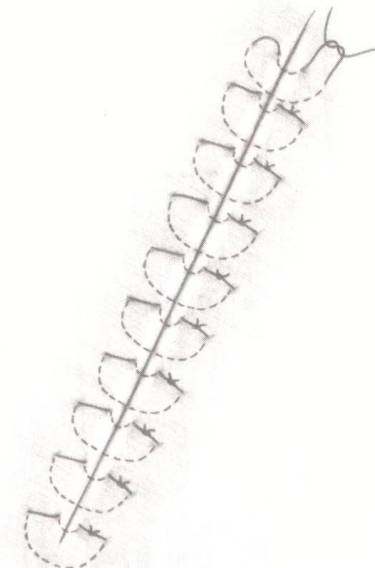
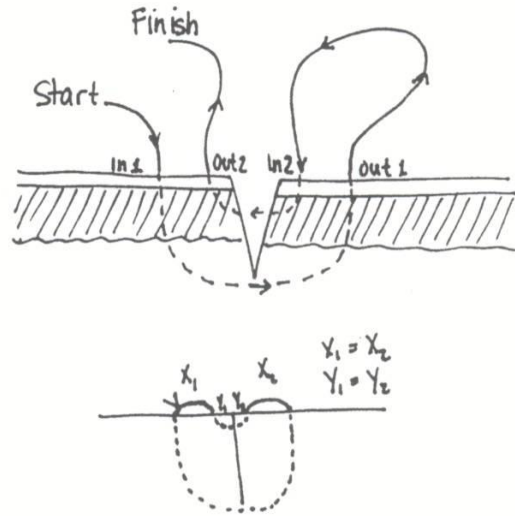
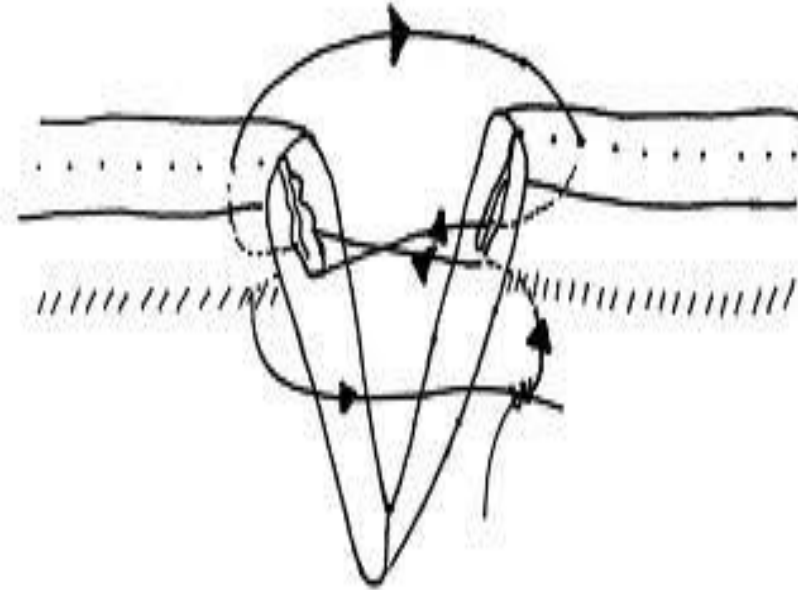


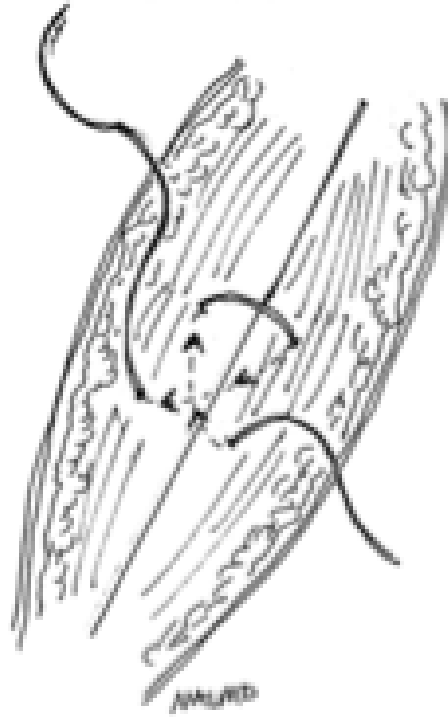
Figure of 8

- ▶ 1 stitch equals 2
- ▶ Better tensile strength
- ▶ Common uses:
 - ▶ Areas over joints
 - ▶ Tie off bleeders
 - ▶ When the area moves
 - ▶ Tying in Tubes
 - ▶ Chest tubes



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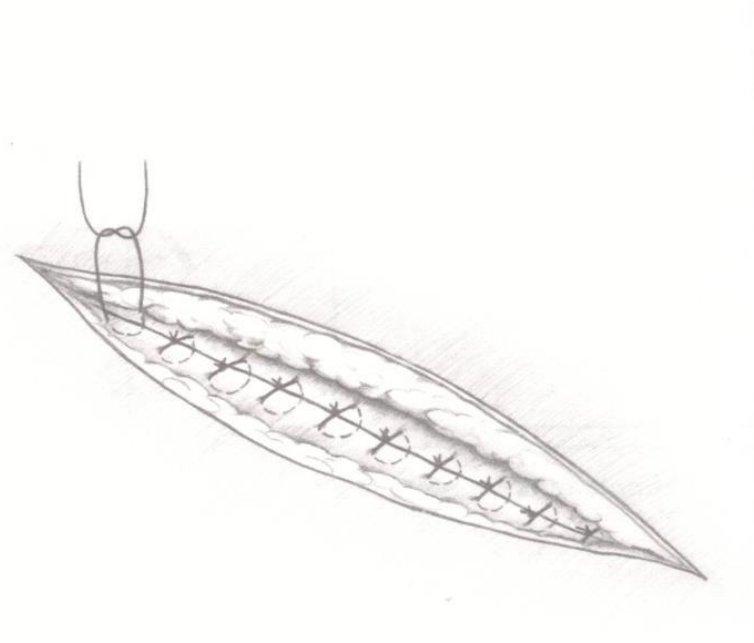
Figure of 8 Method



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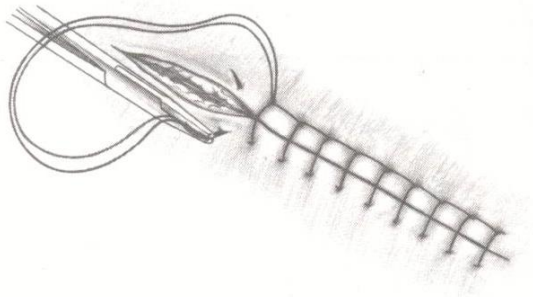
Deep buried interrupted

- ▶ Adds tensile strength esp. in cosmetic areas
- ▶ Allows for earlier removal of cutaneous suture
- ▶ Start first stitch deep on the opposite side, as if using simple suture
 - ▶ Bury knot
- ▶ Must use absorbable suture

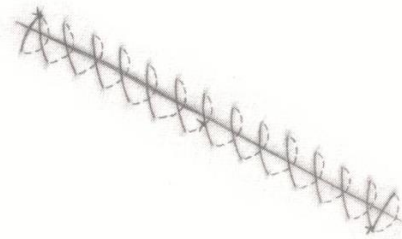


Continuous

Interlocking

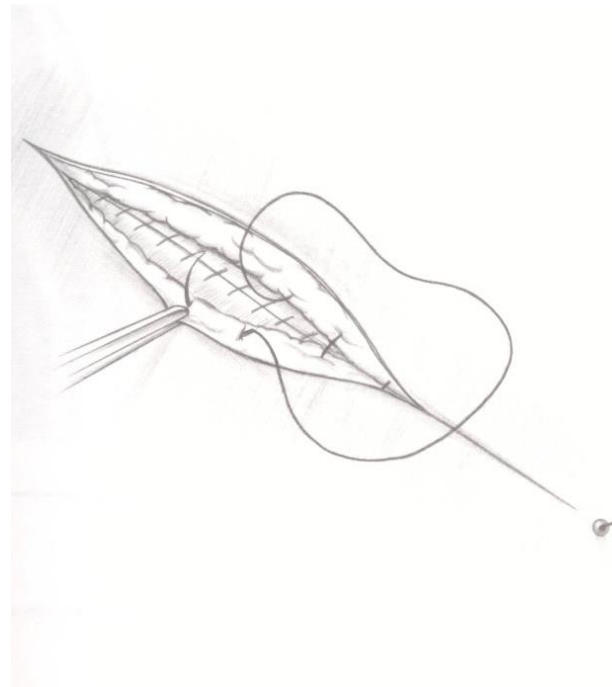


Continuous



Continuous/subcuticular

- ▶ Poor tensile strength
- ▶ More risk of infection
- ▶ Great to decrease scar in those prone to hypertrophic scars or Keloids
- ▶ Must use absorbable



Antibiotics

- ▶ Prophylactic antibiotics
 - ▶ Used in mammal bites
 - ▶ Augmentin/Unasyn
- ▶ No proven benefit of prophylactic in non-bites*
- ▶ Is wound already infected?
 - ▶ Start on ABX to cover skin flora
- ▶ *Diabetics should have gram negative coverage for leg and foot wounds

When to follow up

- ▶ Infection prone wound
 - ▶ 48-72 hours
- ▶ Any of the following signs/symptoms:
 - ▶ Fever
 - ▶ Redness
 - ▶ Wound site ascending lymphangitis
 - ▶ Increasing pain
 - ▶ Systemic signs of illness
 - ▶ Nausea, Vomiting
 - ▶ Wound dehiscence

Glue

- ▶ 4-5 coats equals a 4.0 suture in tensile strength
- ▶ Avoid Ointments and Creams
- ▶ Do not apply to areas with hair
 - ▶ Eyebrows
 - ▶ Scalps



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