Sutures and Suturing

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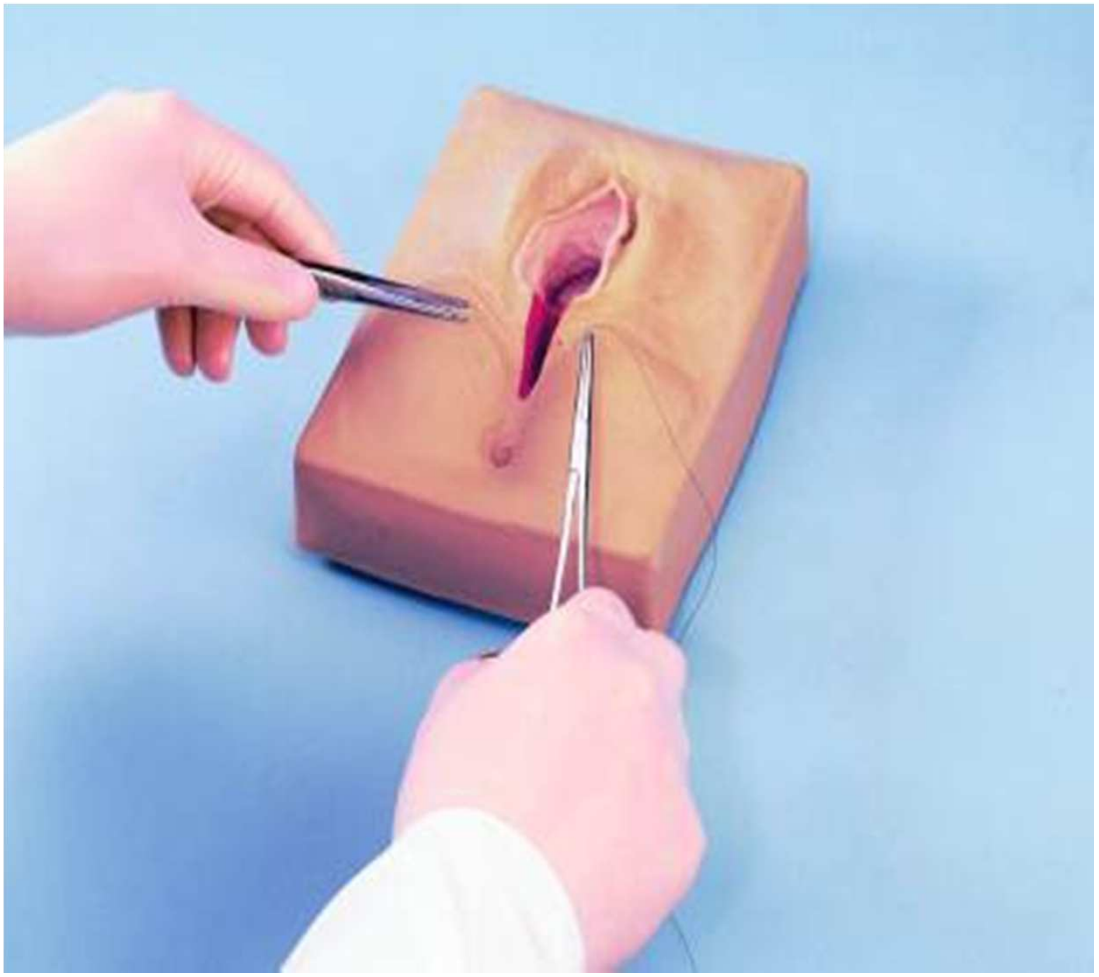
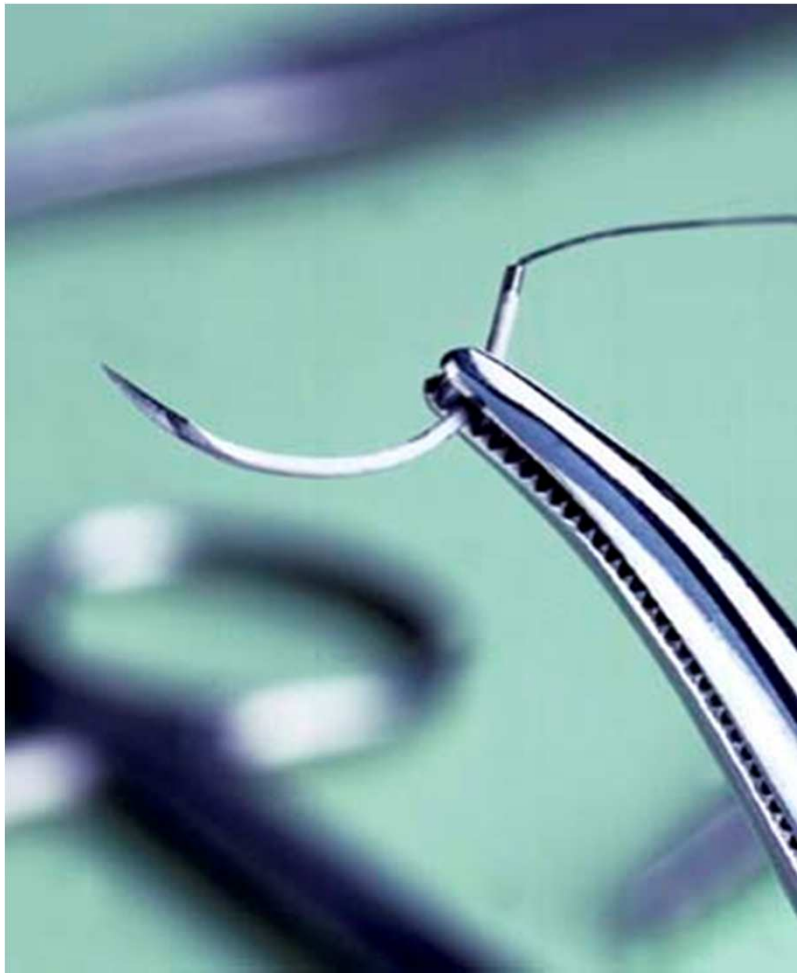




Goals of suturing:

1- Provide an adequate tension of wound closure without dead space but loose enough to obviate tissue ischemia and necrosis.
2- Maintain hemostasis.
3- Permit primary intention healing
4- Reduce postoperative pain
5- Provide support for tissue margins until they have healed and the support no longer needed
6- Prevent bone exposure resulting in delayed healing and unnecessary resorption
7- Permit proper flap position

The Ideal Suture Material:

- Can be used in any tissue
- Easy to handle
- Good knot security
- Minimal tissue reaction
- Unfriendly to bacteria
- Strong yet small
- Won’t tear through tissues
- Cheap

Suture Material:

Generally categorized by three characteristics:

- Absorbable vs. non-absorbable
- Natural vs. synthetic
- Monofilament vs. multifilament

Absorbable Suture:

- Degraded and eventually eliminated in one of two ways:
  - Via inflammatory reaction utilizing tissue enzymes
  - Via hydrolysis
- Examples:
  - “Catgut”
  - Chromic
  - Vicryl
  - Monocryl
  - PDS
- Internal
- Intradermal/ subcuticular
- Rarely on skin

Non-absorbable Suture:

- Not degraded, permanent
- Examples:
  - Prolene
  - Nylon
  - Stainless steel
  - Silk*

(*not a truly permanent material; known to be broken down over a prolonged period of time—years)

Primarily Skin

- Needs to be removed later

Stainless steel = exception

- Can be used internally
  - Ligature
  - Orthopedics
- Can be left in place for long periods

Choosing:

Absorbable Vs. Nonabsorbable

- How long you need it to work
- Do you want to see the patient again for suture removal

Natural Suture:

- Biological origin
- Cause intense inflammatory reaction
- Examples:
  - “Catgut” – purified collagen fibers from intestine of healthy sheep or cows
  - Chromic – coated “catgut”
  - Silk

Synthetic Suture:

- Synthetic polymers
- Do not cause intense inflammatory reaction
- Examples:
  - Vicryl
  - Monocryl
  - PDS
  - Prolene
  - Nylon

Natural Vs. Synthetic

- Natural:
  - Gut
  - Chromic Gut
  - Silk
  - Collagen
- All are absorbable

Monofilament Suture:

- Grossly appears as single strand of suture material; all fibers run parallel
- Minimal tissue trauma
- Resists harboring microorganisms
- Ties smoothly
- Requires more knots than multifilament suture
- Possesses memory
- Examples:
  - Monocryl, PDS, Prolene, Nylon

Multifilament Suture:

- Fibers are twisted or braided together
- Greater resistance in tissue
- Provides good handling and ease of tying
- Fewer knots required
- Examples:
  - Vicryl (braided)
  - Chromic (twisted)
  - Silk (braided)

Monofilament	Vs.	Multifilament
• memory		easy to handle
• less tissue drag		more tissue drag
• doesn’t wick		wicks/ bacteria
• poor knot security		good knot security
• **-** tissue reaction		**+**tissue reaction

Suture Degradation

Suture Material	Method of Degradation	Time to Degradation
“Catgut”	Proteolytic enzymes	Days
Vicryl, Monocryl	Hydrolysis	Weeks to months
PDS	Hydrolysis	Months

Suture Size:

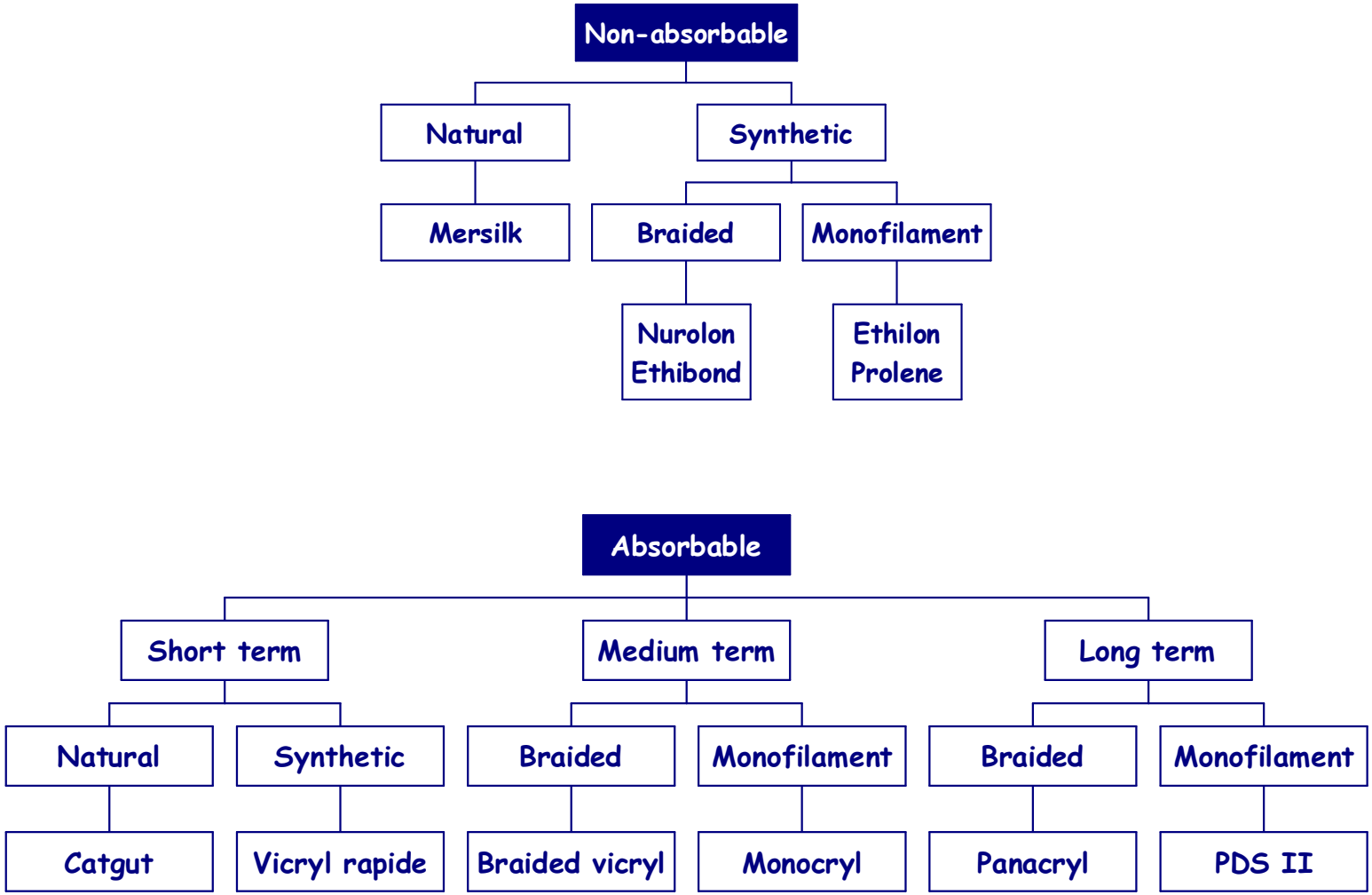
- Sized according to diameter with “0” as reference size
- Numbers alone indicate progressively larger sutures (“1”, “2”, etc)
- Numbers followed by a “0” indicate progressively smaller sutures (“2-0”, “4-0”, etc)

Smaller ←----------

----------→Larger

.....”3-0”...”2-0”...”1-0”...”0”...”1”...”2”...”3”.....

Instruments: Suture material summary

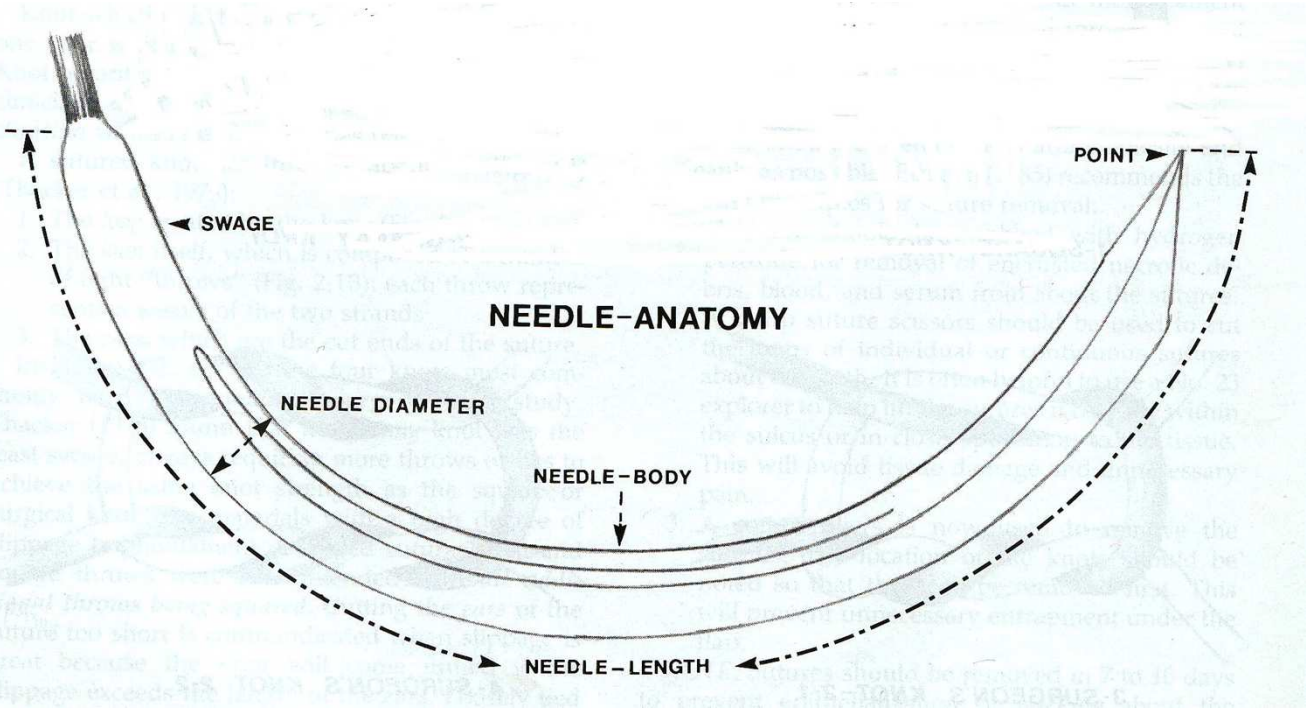


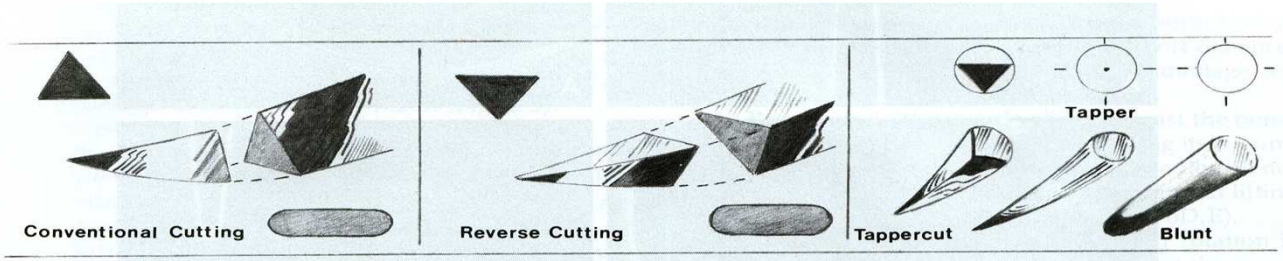
Surgical Needles

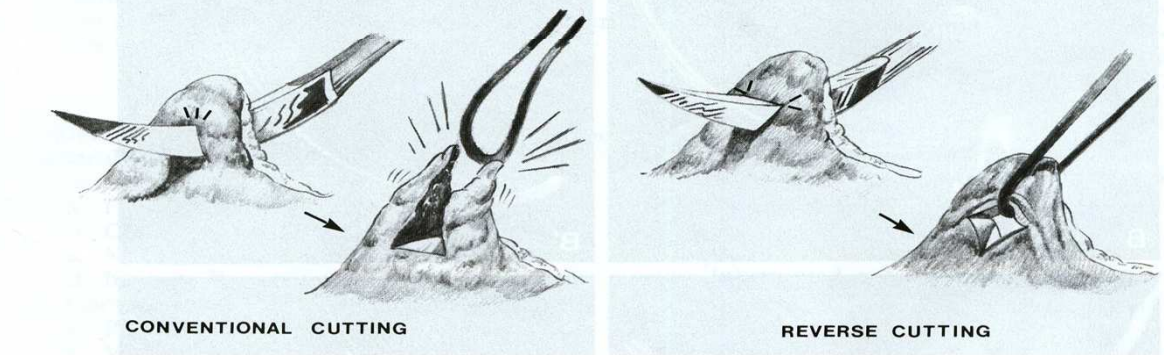
- Most of surgical needles are fabricated from heat treated steel
- The surgical needle has a basic design composed of three parts
  1- The *eye* which is swaged and permits the suture and needle to act as a single unit to decrease trauma

2- The *body* which is the widest point of the needle and is also referred to as the grasping area. The body comes in number of shapes (round, oval, rectangular, trapezoid, or side flattened)

3- The *point* which runs from the tip to the maximum cross-sectional area of the body. The point also comes in a number of different shapes (conventional cutting, reverse cutting, side cutting, taper cut,taper, blunt


NEEDLE-ANATOMY
POINT
SWAGE
NEEDLE DIAMETER
NEEDLE-BODY
NEEDLE-LENGTH


Conventional Cutting
Reverse Cutting
Tapper
Tappercut
Blunt


CONVENTIONAL CUTTING
REVERSE CUTTING

Needle Holder Selection

1- Use an approximate size for the given needle. The smaller the needle, the smaller the needle holder required

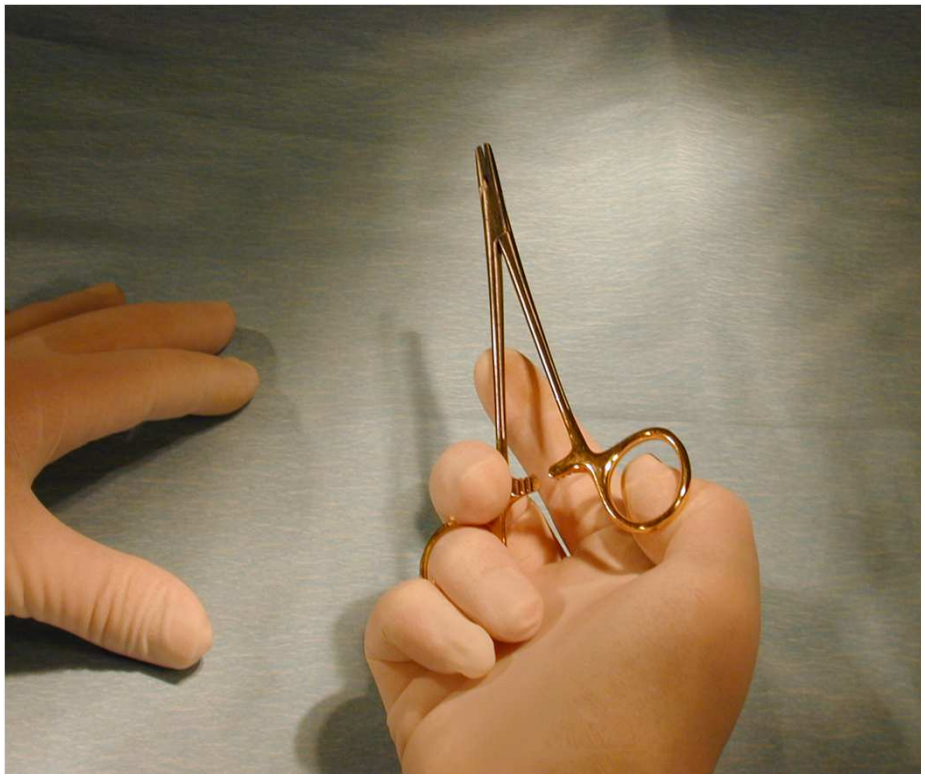
2- Needle should be grasped one-quarter to one half the distance from the swaged area

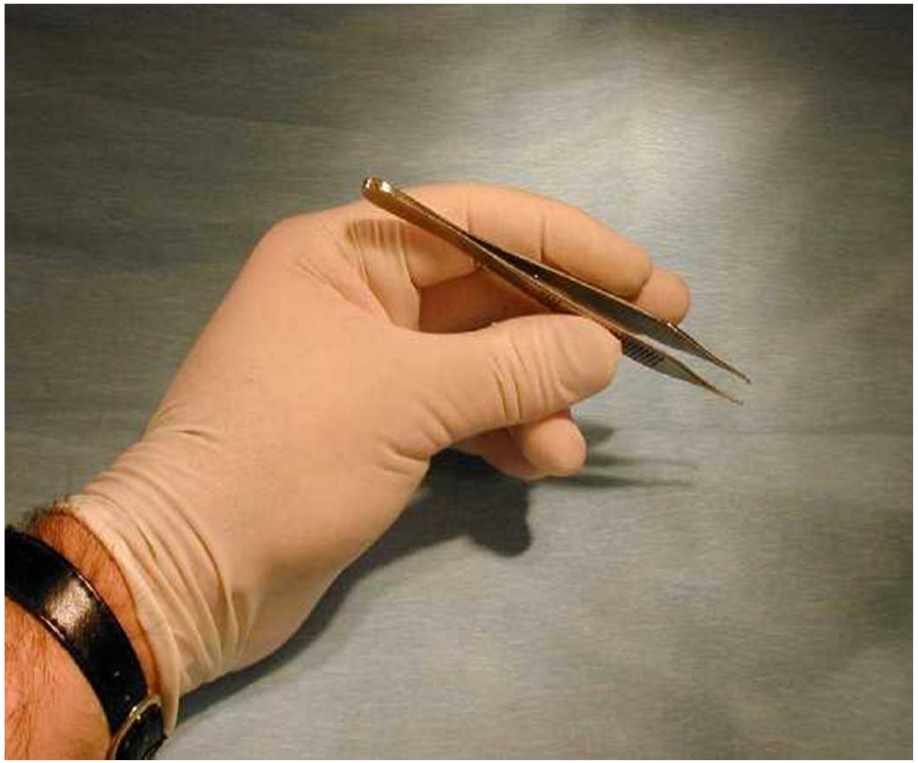
3- The tip of the jaws of the needle holder should meet before remaining portion of the jaws

4- The needle should be placed securely in the tips of the jaws and should not rock, twist, or turn

5- Do not over close the needle holder. It should close only to the first or second ratchet. This will avoid damaging the needle

6- Pass the needle holder so it is always directed by the operator thumb





Placement of Needle in Tissue

1- Force should always be applied in the direction that follows the curvature of the needle

2- Suturing should always be from movable to a nonmovable tissue

3- Avoid excessive tissue bites with small needle as it will be difficult to retrieve them

4- Use only sharp needles with minimal force. Replace dull needles

5- Never force the needle through the tissue

6- Grasp the needle in the body one-quarter to one-half of the length from the swaged area. Do not hold the swaged area; this may bend or break the needle. Do not grasp the point area as damage or notching may result

7- Avoid retrieving the needle from the tissue by the tip. This will damage or dull the needle

8- Suture should be placed in keratinized tissue whenever possible

9- An adequate tissue bite is required to prevent the flap from tearing

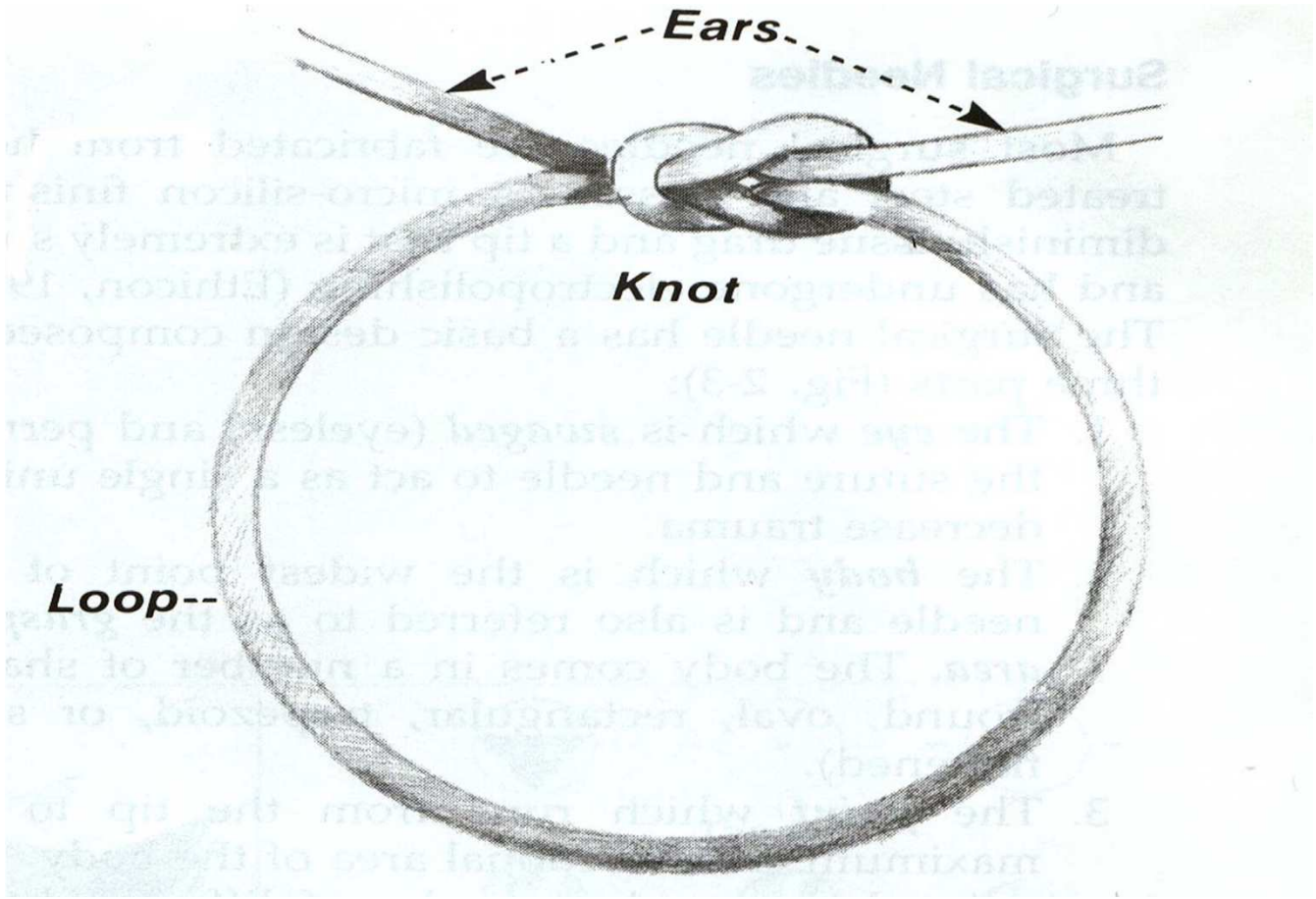
Knots

A suture knot has three components

1- The *loop* created by the knot

2- The *knot* itself, which is composed of a number of tight “throws”, each throw represents a weave of the two stands

3- The *ears*, which are the cut ends of the suture


Ears
Knot
Loop--

Principles of Suturing

1- The completed knot must be tight, firm, and tied so that slippage will not occur

2- To ovoid wicking of bacteria, knot should not be placed in incision lines

3- Knots should be small and the ends cut short (2-3mm)

4- Avoid excessive tension to finer gauge materials as breakage may occur

5- Avoid using a jerking motion, which may break the suture

6- Avoid crushing or crimping of suture materials by not using hemostats or needle holders on them except on the free end for tying

7- Do not tie suture too tightly as tissue necrosis may occur. Knot tension should not produce tissue blanching

8- Maintain adequate traction on one end while tying to ovoid loosing the first loop

Reading the Suture Label

Size

Order Code

Name

Needle

Also:

LENGTH

NEEDLE SYMBOL

COLOR

Absorbable or Non

- Company

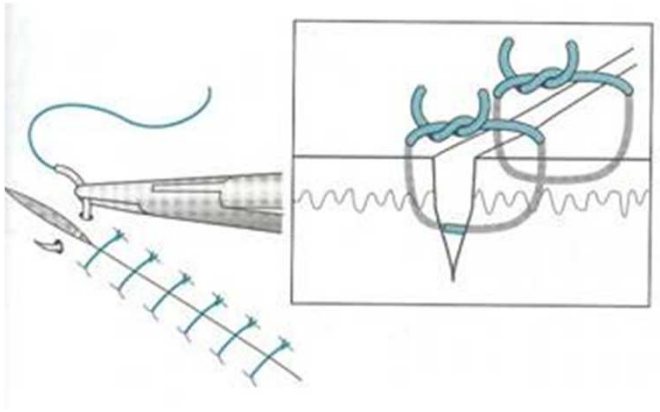
Basic suturing techniques:

- Simple sutures
- Mattress sutures
- Subcuticular sutures

- Goal: “approximate, not strangulate”

Simple interrupted stitch:

- Single stitches, individually knotted (keep all knots on one side of wound)
- Used for uncomplicated laceration repair and wound closure



Arming the needle-holder

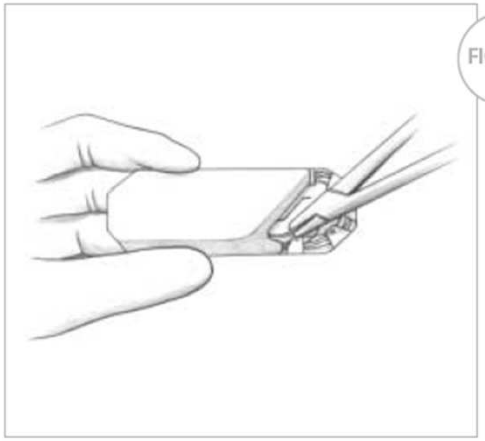


FIGURE 2

METHOD FOR PREPARING ONE-STEP RELAY PACKAGE SUTURES

- Open the suture packet with one tear to reveal the needle

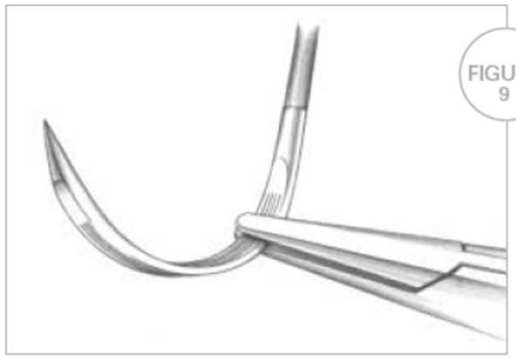


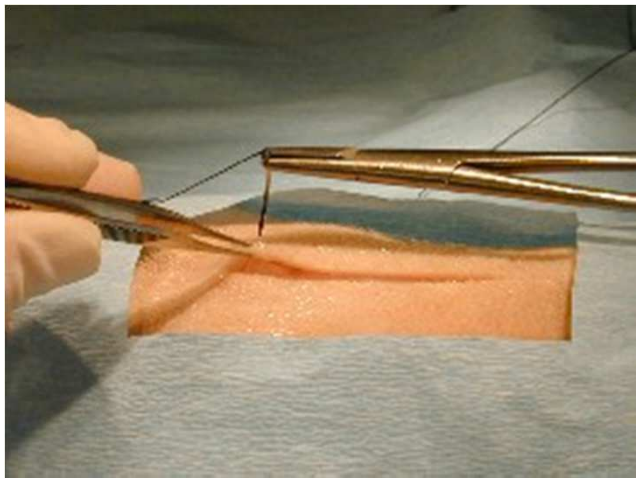
FIGURE 9

ARMING A NEEDLE-HOLDER PROPERLY

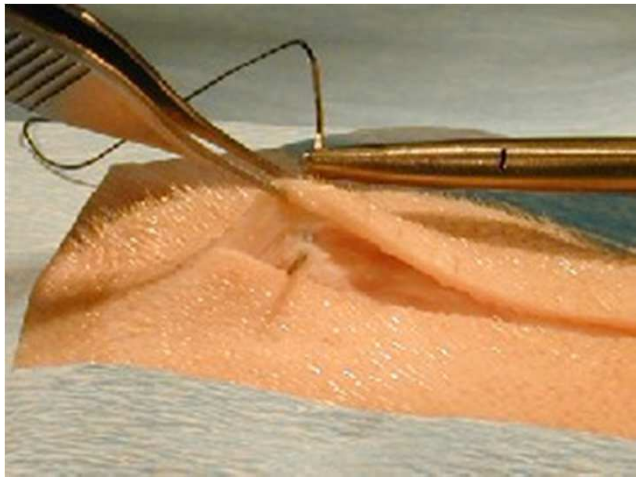
Grasp the needle one-third to one-half of the distance from the swaged end to the point.

- Grasp the needle two-thirds the distance from its pointed end
- Avoid grasping the needle at its proximal or distal extremities since this will prevent damage to the suture

Simple interrupted stitch: Steps 1&2



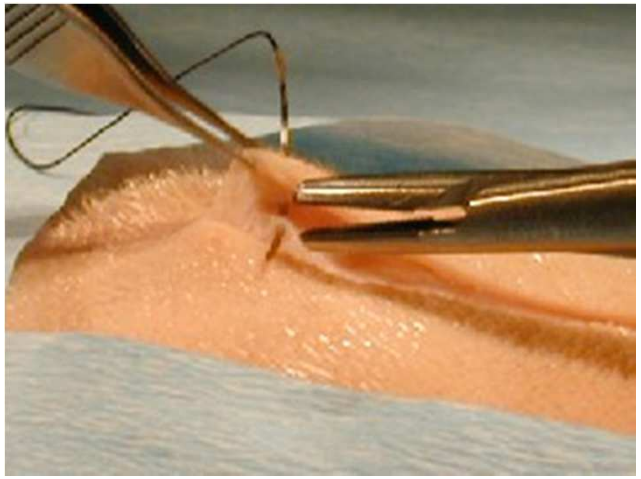
- Grasp the skin edge with the forceps and slightly evert the skin edge
- Then pronate the needle-holder so that the needle will pierce the skin at 90^{o}
- Ensure the trailing suture material is out of the way to avoid tangling



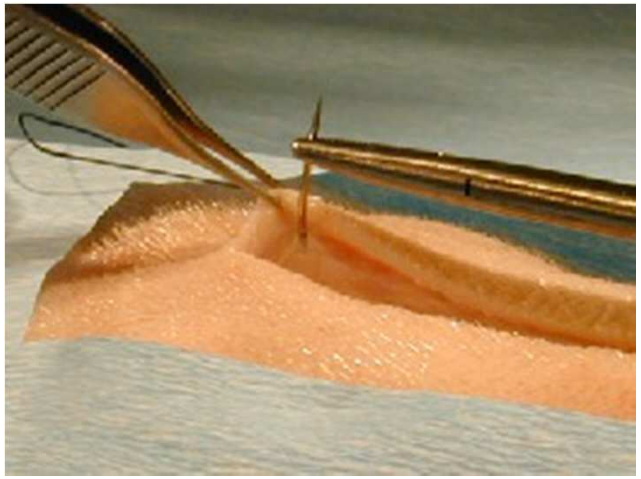
- Drive the needle through the full thickness of the skin by supinating the needle-holder
- Keeping the shaft of the needle perpendicular to the skin allows the curvature of the needle to traverse the skin as atraumatically as possible

Images courtesy of BUMC

Simple interrupted stitch: Steps 3&4

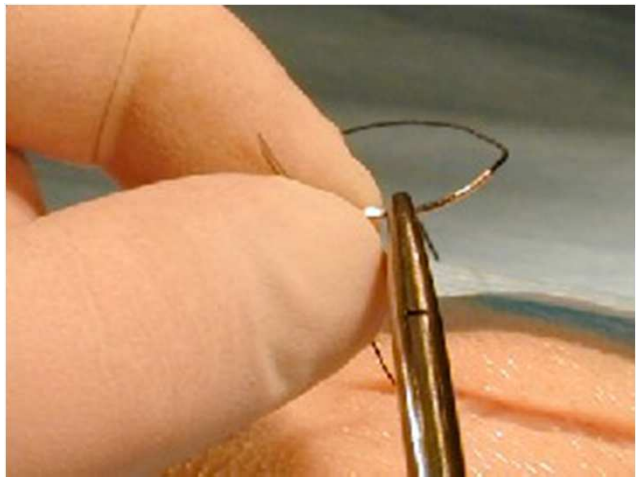


- Release the needle and pronate the needle-holder
- Regrasp the needle proximal to its pointed end
- Maintain tension with the forceps to prevent the needle from retracting

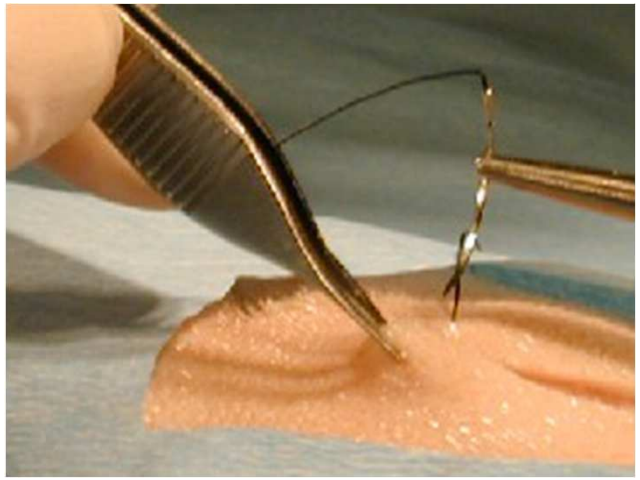


- Again, supinate the needle-holder to rotate the needle upwards and through the tissue

Simple interrupted stitch: Steps 5&6

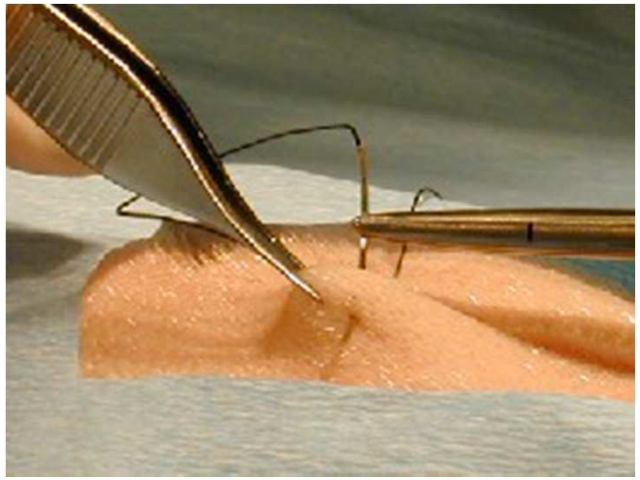


- Regrasp the needle in order to rearm the needle-holder (due to HIV risks it is better to use the forceps to do this)

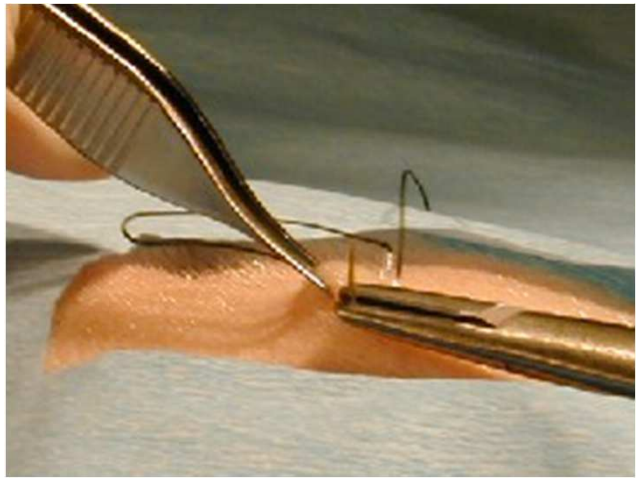


- Grasp and slightly evert the opposing skin edge with the forceps
- Pronate the needle-holder

Simple interrupted stitch: Steps 7&8

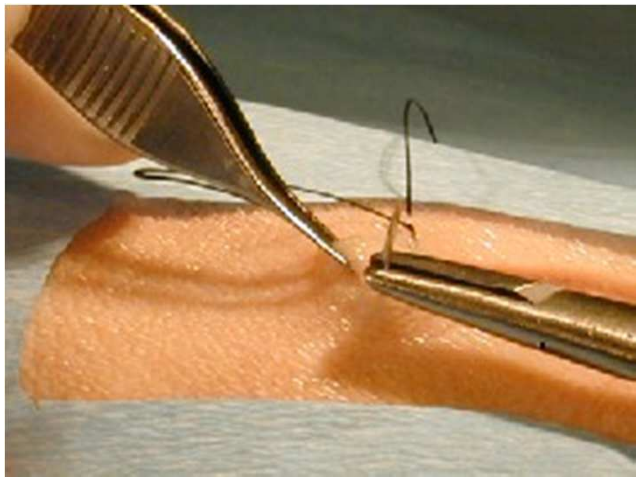


- Again, supinate the needle-holder to rotate the needle through the skin, keeping the shaft 90° to the skin surface

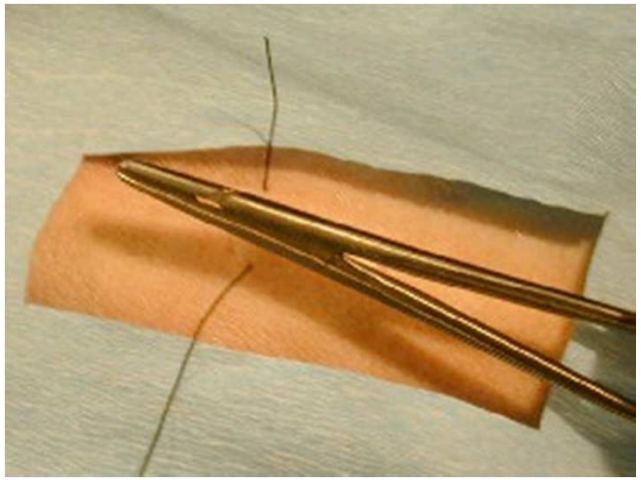


- After releasing the needle, pronate the needle-holder before regrasping the needle…

Simple interrupted stitch: Steps 9&10

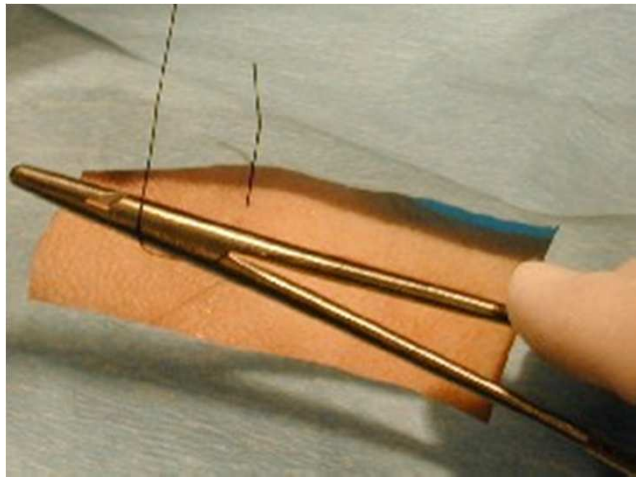


- ...and again supinate the needle-holder to rotate the needle through the skin

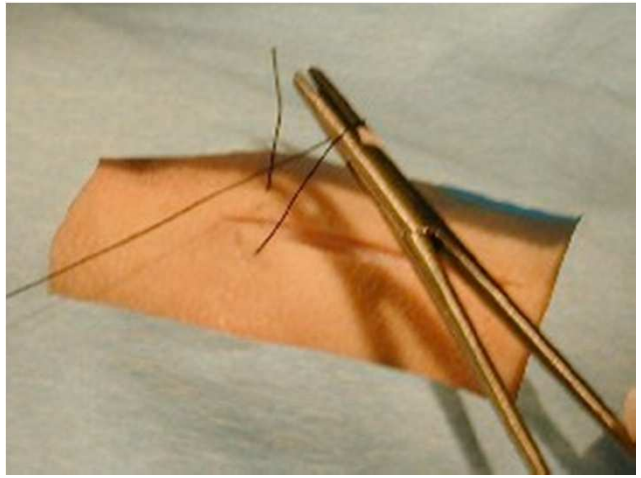


- Pull the suture material through the skin until 2-3 cm is left protruding
- Discard the forceps and use your free hand to grasp the long end in preparation for an instrument tie
- Place the needle-holder between the strands

Simple interrupted stitch: Steps 11&12

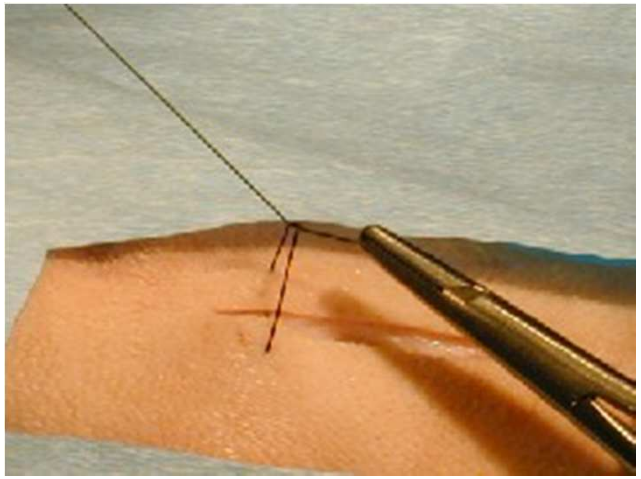


- Wrap the long strand around the needle-holder to form the loop for the first throw of a square knot

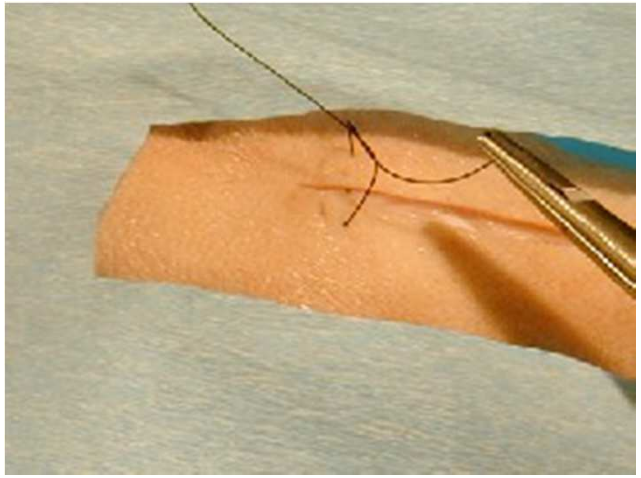


- Rotate the needle-holder away yourself and grasp the short end of the suture

Simple interrupted stitch: Steps 13&14

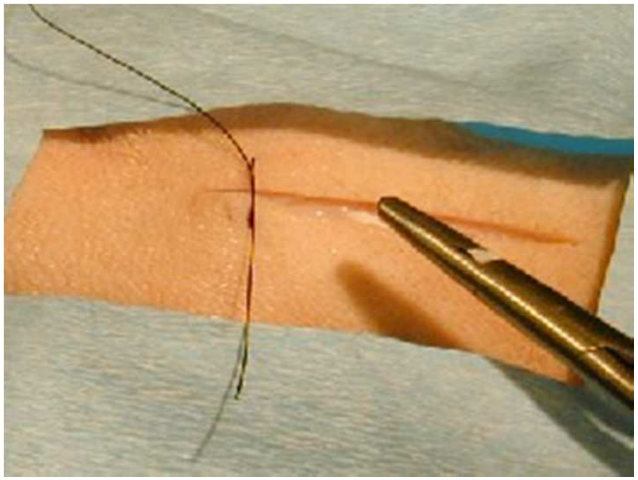


- Now draw the short end back through the loop towards yourself

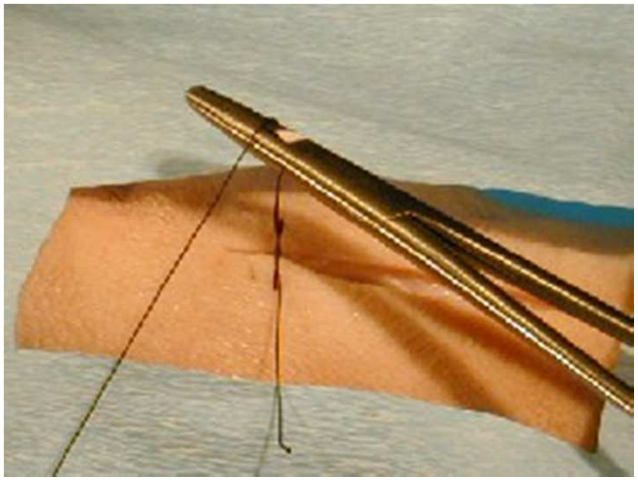


- Now tighten the first throw

Simple interrupted stitch: Steps 15&16

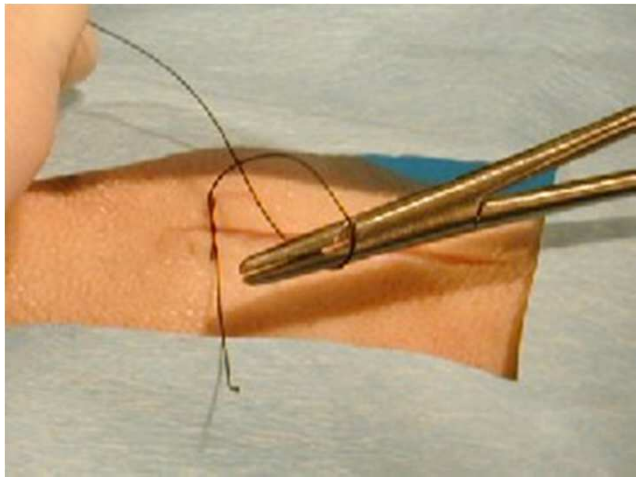


- The throw should be tightened just enough to approximate the skin edges but not enough to strangulate the tissue

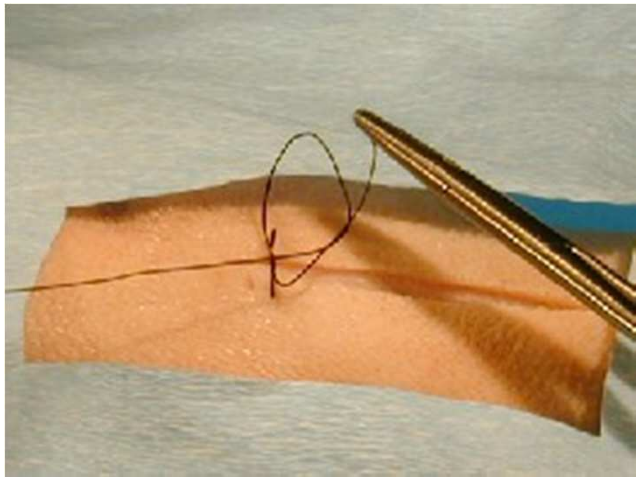


- To begin the second throw of the square knot, wrap the long strand around the needle-holder by bringing the long strand towards yourself

Simple interrupted stitch: Steps 17&18

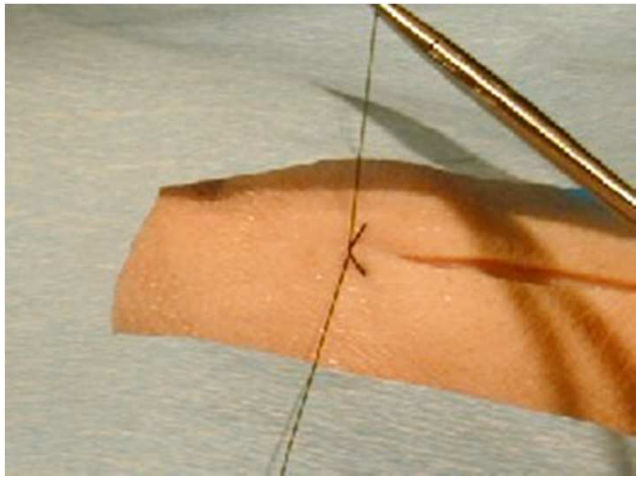


- Rotate the needle-holder towards yourself to retrieve the short end

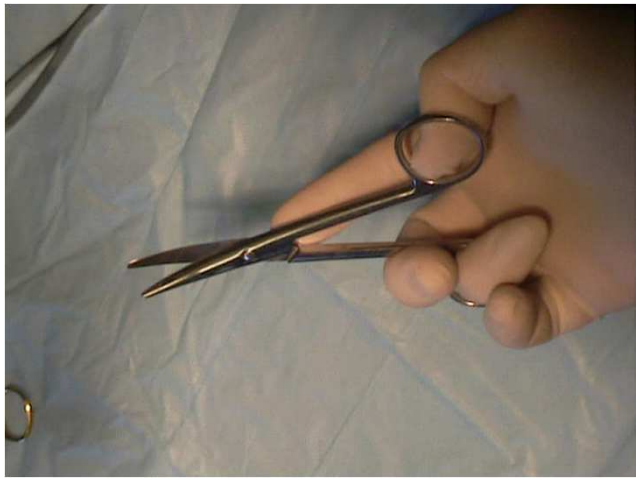


- Grasp the short end and draw it through the loop by pulling it away from yourself

Simple interrupted stitch: Step 19&20



- Finally, tighten the second throw securely against the first
- Ensure the knot is to one side of the wound to avoid involvement in the clot

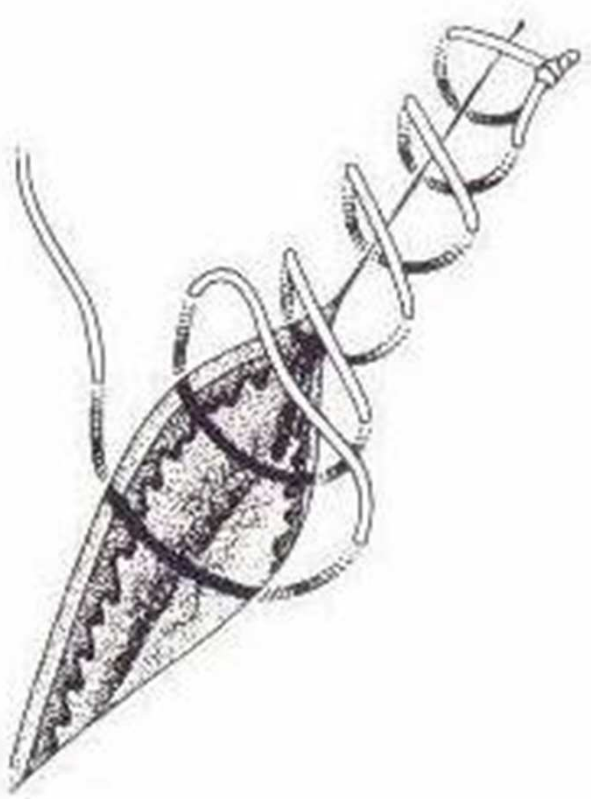


- In one hand hold the scissors as shown
- With the other hand maintain tension on the suture material
- Slide the tips of the scissors down the strands to the point where they will be cut
- Cut the suture material leaving 4-5mm tails (important for removal of external non-absorbable sutures)

Suture removal

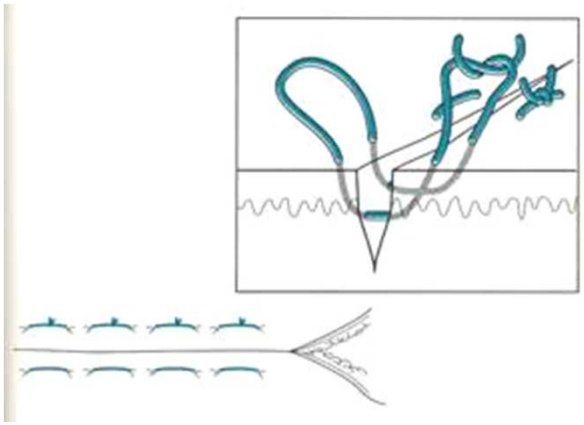
- Sutures should be removed:
  - Face: 3-4 days
  - Scalp: 5 days
  - Trunk: 7 days
  - Limb: 7-10 days
  - Foot: 10-14 days
- Steps involved in removal:
  - Reassure patient that the procedure is not painful
  - Cleanse the skin with hydrogen peroxide
  - Grasp one of the suture ‘tails’ with forceps and elevate
  - Slip the tip of the scissors under the suture and cut close to the skin edge (to minimise the length of contaminated suture that will be pulled through the wound)
  - Gently pull the knot with the forceps and reinforce the wound Proxi-Strips if required

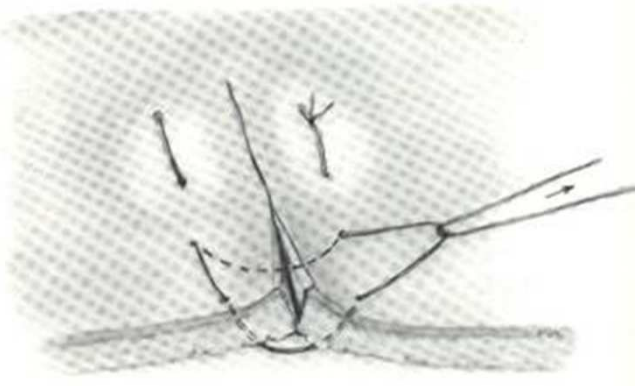
Simple Continuous



Horizontal mattress stitch:

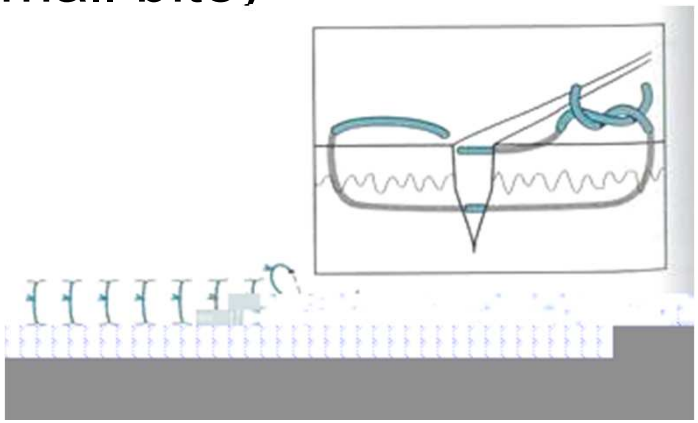
- Provides added strength in fascial closure; also used in calloused skin (e.g. palms and soles)
- Two-step stitch:
  - Simple stitch made
  - Needle reversed and 2nd simple stitch made adjacent to first (same size bite as first stitch)





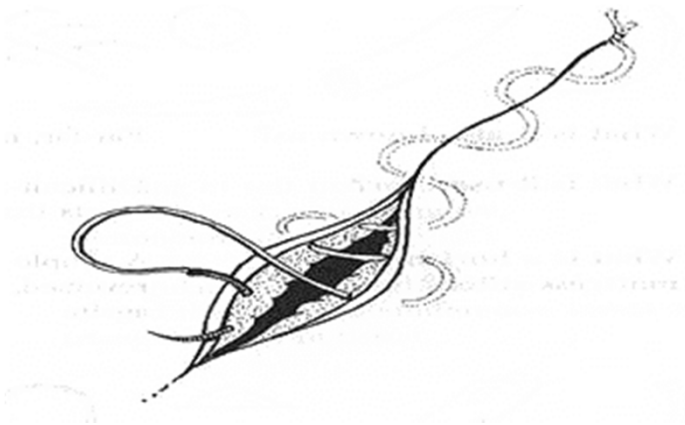
Vertical mattress stitch

- Affords precise approximation of skin edges with eversion
- Two-step stitch:
  - Simple stitch made – “far, far” relative to wound edge (large bite)
  - Needle reversed and 2nd simple stitch made inside first – “near, near” (small bite)



Subcuticular Sutures:

- Usually a running stitch, but can be interrupted
- Intradermal horizontal bites
- Allow suture to remain for a longer period of time without development of crosshatch scarring



Skin Staples

- Very common in human medicine
- Expensive
- Very easy
- Very secure
- Very little tissue reaction
- Removal =
  - Special tool required

Tissue Adhesive

- Nexaband, Vetbond, and others
- Little strength
- Should not be placed between skin layers or inside body

Principles for Suture Removal

1- The area should be swabbed with hydrogen peroxide for removal of encrusted necrotic debris, blood, and serum from about the sutures

2- A sharp suture scissors should be used to cut the loops of individual or continuous sutures about the teeth

3- It is often helpful to use a No. 23 explorer to help lift the sutures if they are within the sulcus or in close opposition to the tissue

4- A cotton pliers is used to remove the suture. The location of the knots should be noted so that they can be removed first. This will prevent unnecessary entrapment under the flap

Suture should be removed in 7 to 10 days to prevent epithelialization or wicking about the suture

Summary

- Wound classification
  - Clean
  - Clean, contaminated
  - Contaminated
  - Infected
- Types of wound healing
  - Primary intention
  - Secondary intention
  - Delayed primary closure
- Suture material
  - Properties
    - Natural or synthetic
    - Non-absorbable or absorbable
    - Monofilament or multifilament
  - Size
    - Ranges from 3 – 12/0