

FIGURE 23-3 The parts of taper, reverse, and conventional cutting needles are shown (left to right). (Modified from Trott AT. Wounds and Lacerations: Emergency Care and Closure, ed 2. St. Louis: Mosby-Year Book; 1998, p 31.)

PROCEDURE

PERFORMING SUTURE TECHNIQUES (GENERAL INFORMATION)

CAUTION: Proper instrument technique is paramount.

Needle Driver-Holder

1. Using sterile gloves, hold the needle driver with the dominant hand while the nondominant hand holds the forceps.

NOTE: The tripod grip is an excellent method for use with both the needle driver and scissors because it maximizes hand control (Figure 23-4). This may include the distal phalanx of the thumb and fourth digit inserted into the rings of the needle driver but never allowing the digits to move into rings more proximal than the distal interphalangeal joint.

Sun Bunlorn, MD-Medical Knowledges page

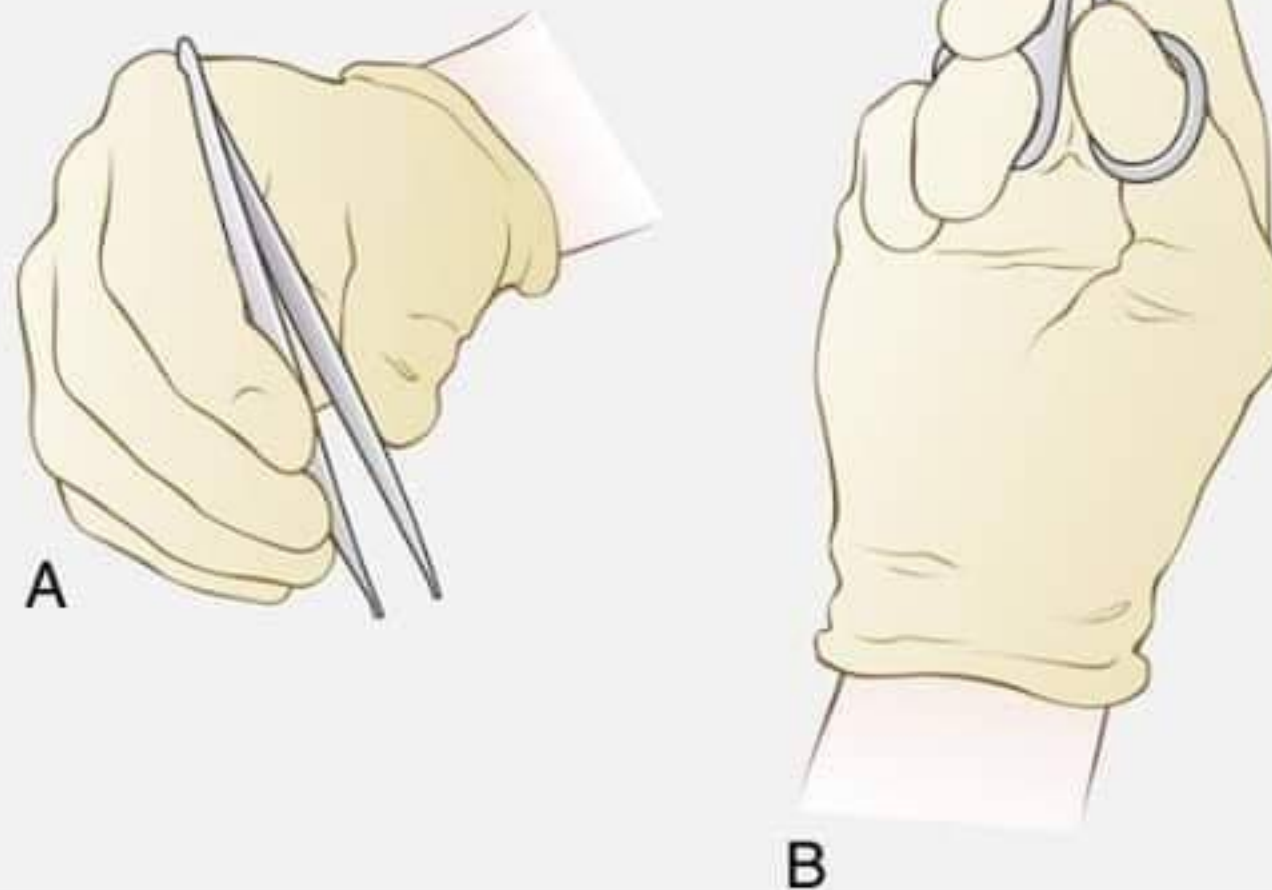


FIGURE 23-4 (Modified from Trott AT. Wounds and Lacerations: Emergency Care and Closure, ed 2. St. Louis: Mosby-Year Book; 1998, p 32.)

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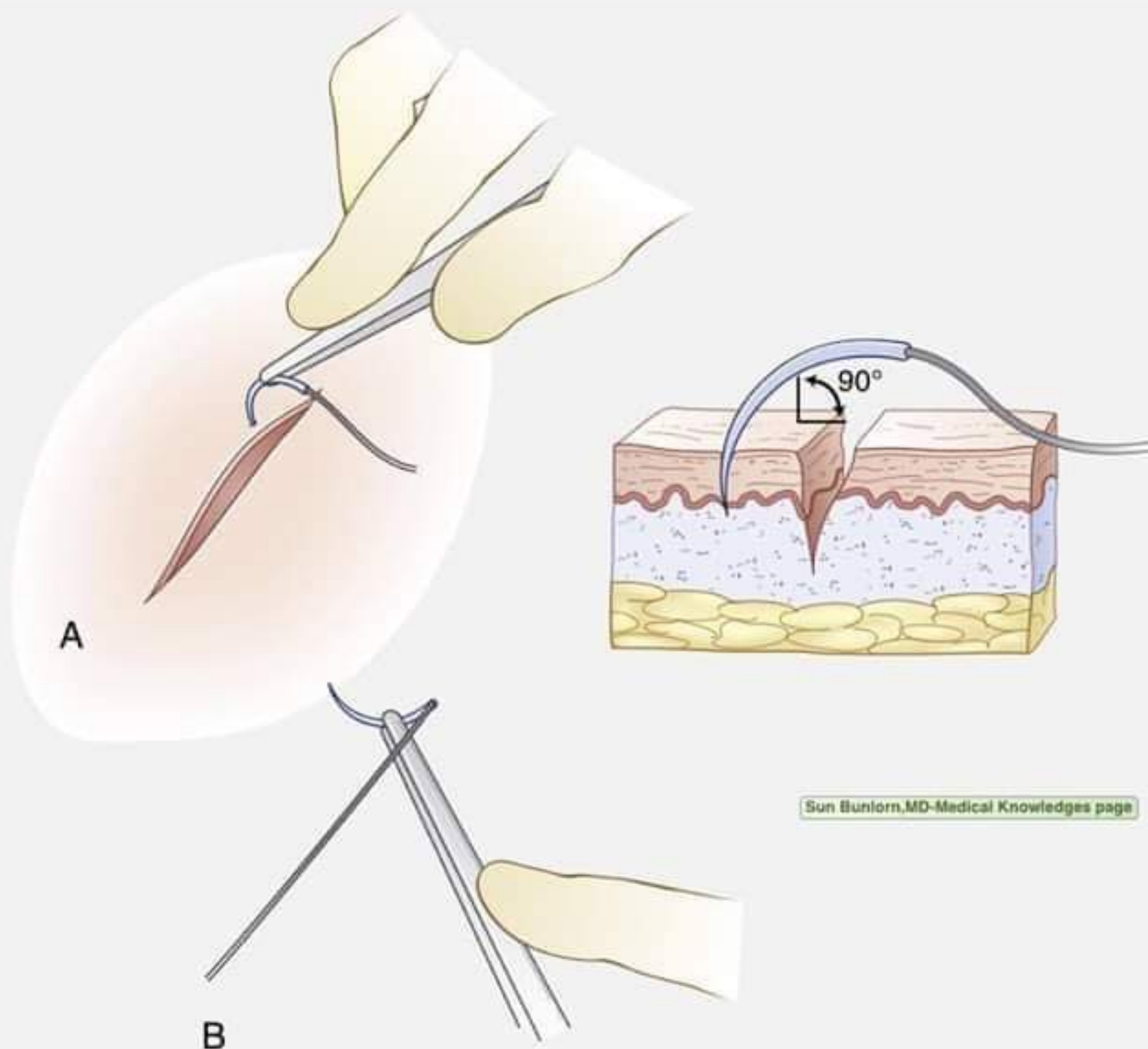


FIGURE 23-5 (Modified from Trott AT. Wounds and Lacerations: Emergency Care and Closure, ed 2. St. Louis: Mosby-Year Book; 1998, p 33.)

2. Grasp the needle at the tip of the needle driver and load so that it is perpendicular to the needle driver, as shown in Figure 23-5.

NOTE: The needle concavity will be furthest from the clinician, and the point of the needle will be pointing to the nondominant shoulder as the clinician views the needle.

3. Grasp the needle at the junction of its proximal and middle third. It can be moved more distal (toward the point) for smaller bites.

NOTE: The tip of the needle should never be grasped because it can become dull.

Forceps

1. For maximal control, hold the forceps like a pencil, as shown in Figure 23-4.

NOTE: If the forceps have teeth, avoid a tight tissue grasp to eliminate skin trauma ("teeth marks").

2. One method lifts the tissue rather than grasping it by placing one tooth of the forceps into the wound edge and lifting gently without closing the other toothed face to the skin surface.

Scissors

1. Cut with the tips of the scissors using the tripod grip and with the screw of the scissors facing up and at a 45-degree angle to the suture as in Figure 23-4.

NOTE: Scissors are manufactured to cut most accurately with the tips.

NOTE: The technique of cutting at a 45-degree angle helps eliminate the possibility of accidentally cutting out the knots when no tail is left intraoperatively.

To minimize needlestick injuries, needles should never be touched with the fingers; they can be loaded easily from the packet they come in or from any flat surface.

Never attempt to cut a suture without full visualization of the distal scissor tips to avoid cutting tissue inadvertently.

PROCEDURE

SUTURE PLACEMENT

1. Introduce the suture needle into the tissue at a 90-degree angle or less (toward the wound) (see Figure 23-5); try to approximate this angle as closely as possible. This can be maximized with full wrist pronation.

NOTE: This is to promote skin eversion or a slight tenting of the wound edge at closure to minimize the ultimate scar visibility. With time, a normal scar contracts and flattens and appears flush, casting no shadow. Conversely, a wound that initially is closed flush often later “sinks-in” and creates a shadow of light that highlights and draws attention to the scar.

NOTE: The depth of needle penetration is determined by the wound depth. Sometimes a bite can be completed by one pass through the tissue (skin surface, wound edge, wound edge, skin surface); other times the needle should be reloaded halfway through or after it passes from skin surface through the first wound edge. This allows for specific placement of the wound edge to the adjacent wound edge to ensure a side-to-side match and is necessary for larger bites in a deep wound. Typically, the total stitch length should be as wide as the wound is deep, as shown in Figure 23-6.

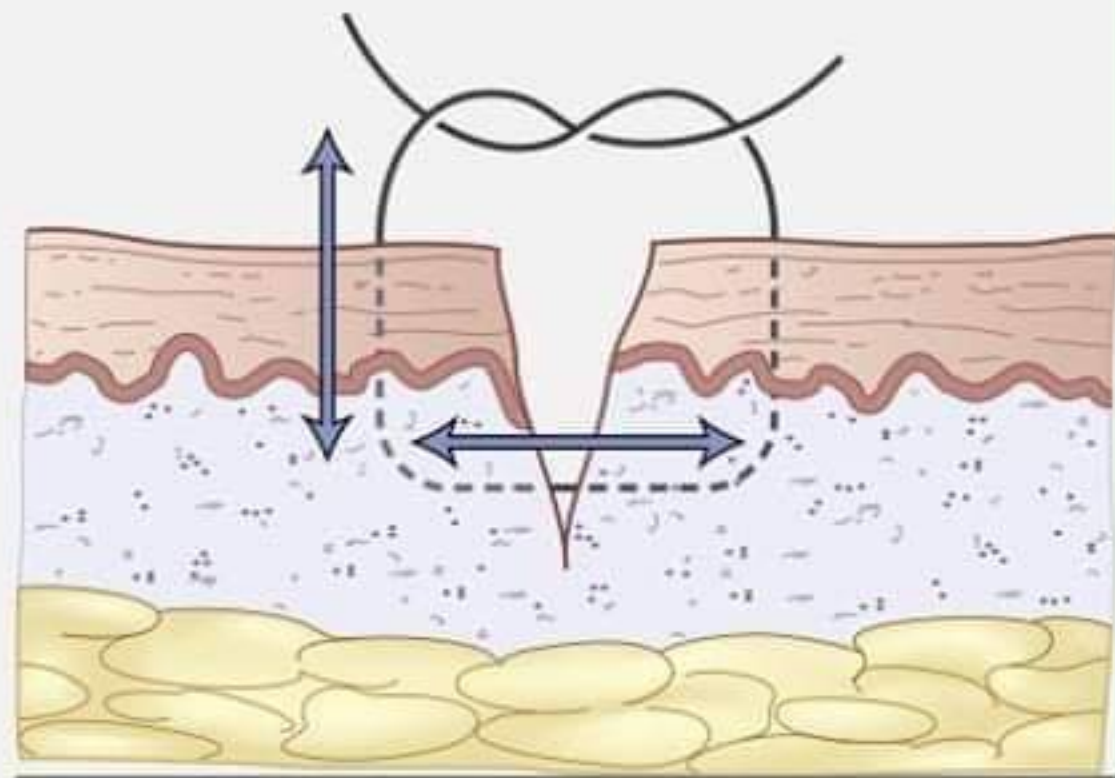


FIGURE 23-6 (Modified from Trott AT. Wounds and Lacerations: Emergency Care and Closure, ed 2. St. Louis: Mosby-Year Book; 1998, p 113.)

NOTE: If a needle begins to bend, excessive pressure has been placed on it by either poor technique or attempting too large a bite. Taking a bite deeper than the wound may cause important structures to be traumatized from blind needle placement. Conversely, taking too superficial a bite may leave dead space below the closure, inviting blood accumulation, bacterial growth, and infection.

2. Place the needle bite just superficial to the wound depth.

NOTE: This allows complete visualization of structures penetrated and adequately closes the wound.

Sun Bunlorn, MD-Medical Knowledges page

PROCEDURE

PERFORMING THE INSTRUMENT TIE

1. Place the needle driver between the suture ends and, with the nondominant hand, wrap the suture with the needle attached over the instrument twice on the first throw of the first knot only (surgeon's knot, used to prevent slippage) (Figure 23-7, A and B).
2. Grasp the short end of the suture with the needle driver, and the short and long suture ends switch sides (see Figure 23-7, C).

NOTE: This is considered one throw. Two throws makes one knot. Next, the needle driver is placed between the two suture ends, and one wrap of the long suture over the instrument is used (Figure 23-7, D).

3. Again, grasp the short suture end with the needle driver. The long and short

suture ends again switch sides (see Figure 23-7, E).

NOTE: A circle should be seen as the suture comes down to the skin surface. This suture circle should be placed at 90 degrees to the wound length for simple interrupted and vertical mattress sutures (horizontal mattress sutures will be parallel with the wound) (see Figure 23-7, F).

4. Repeat these steps with only one wrap over the needle driver on every successive throw until the suture is cut.

NOTE: Remember, the only throw that gets two wraps is the first throw of the first knot in a series. Therefore an even number of throws ensures completion of all knots. Compare the diagrams of a typical knot (see Figure 23-6) with a surgeon's knot (see Figure 23-7, G).

Continued

After an adequate number of knots are secured, pull the suture knot to one side to avoid knot placement directly over the wound to minimize debris collection and potential infection.

NOTE: The number of knots depends on the anatomic location (below the skin surface requires fewer knots; above the skin surface requires more knots) and suture material (those with "memory" often require more knots). Usually three or four knots on the skin surface are sufficient. The needle remains connected throughout these steps and usually poses no problem to the clinician or patient, because it remains stationary lying on the sterile field. There is no need to remember where you are in a sequence with this method, as in the "over-under technique."

NOTE: The suture is now ready for cutting. The "suture tail" or "suture tag" will be used during suture removal.

NOTE: Two helpful rules can be used to estimate this length: (1) The tail length should be equal to the distance from the wound edge to the suture border. (2) The tail length should be slightly less than the distance between adjacent knots. Use the previously described scissor technique to cut the suture.

Sun Bunlorn, MD-Medical Knowledge page

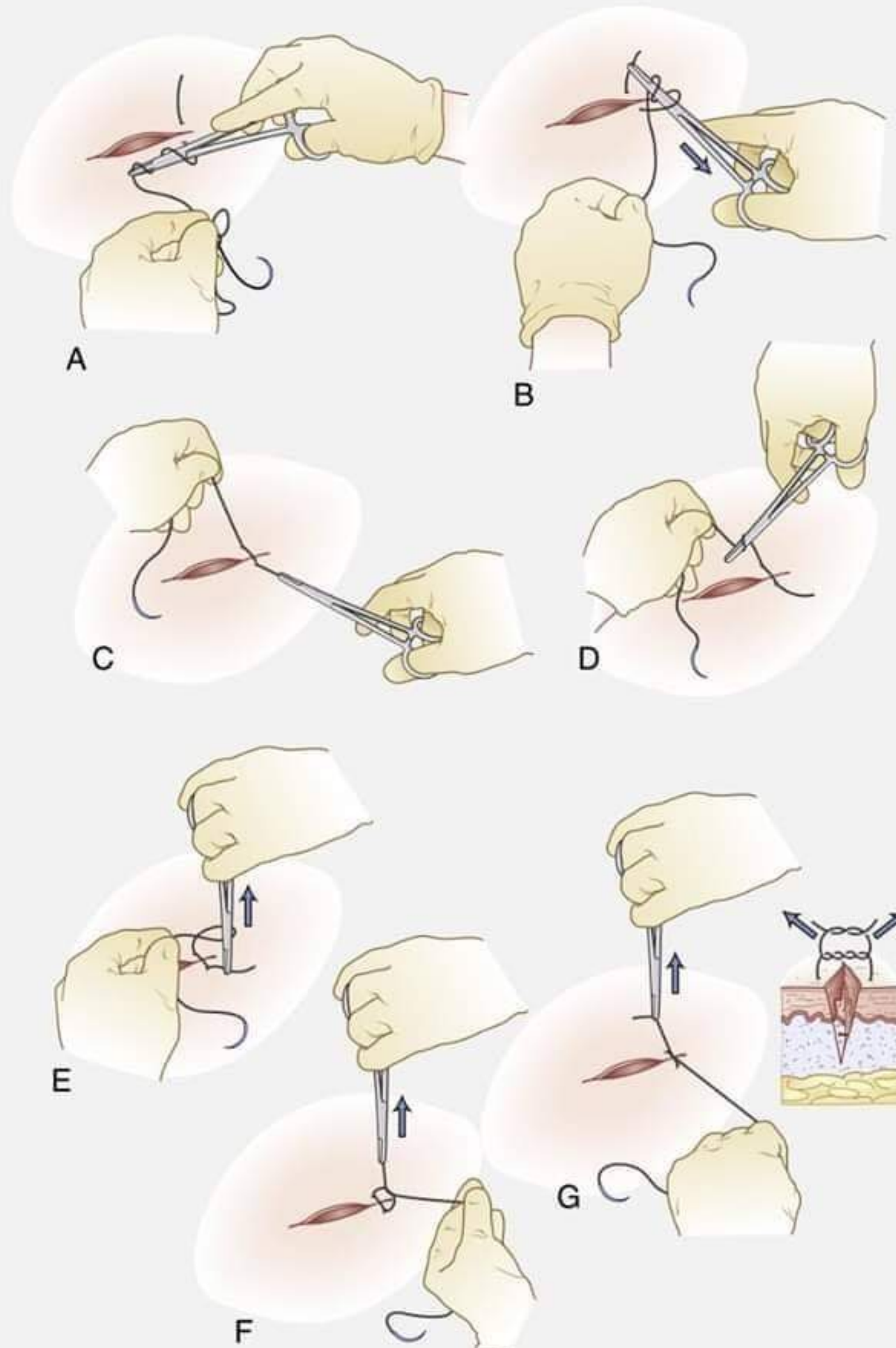


FIGURE 23-7 (Modified from Trott AT. Wounds and Lacerations: Emergency Care and Closure, ed 2. St. Louis: Mosby-Year Book; 1998, pp 98-102.)

PROCEDURE**PERFORMING THE SIMPLE INTERRUPTED STITCH**

It is important to estimate carefully the number and size of sutures necessary to close the wound adequately without placing stitches that are too many and too small or too few and too large. Most simple interrupted stitches should measure between 3 and 10 mm in length and should be about this same distance apart. The method described in the instrument tie section is consistent with the simple interrupted stitch, which is frequently used to close most lacerations.

1. One method of closure includes closure by halves. Place the first stitch at the halfway point along the length of the wound.
2. Place the next stitches at the halfway point between the first stitch and each end of the wound.
3. Place the next stitches between each of the previous stitches until the wound is approximated.

NOTE: An alternative method involves beginning at one end of the wound and placing evenly spaced sutures along the length until you reach the opposite end of the wound. Be careful to place the sutures evenly on both sides of the wound; failure to do so may result in an asymmetrical end to the wound known as a *dog ear*, in which one side of the wound appears to be longer than the other side, creating a redundant "ear" of tissue.

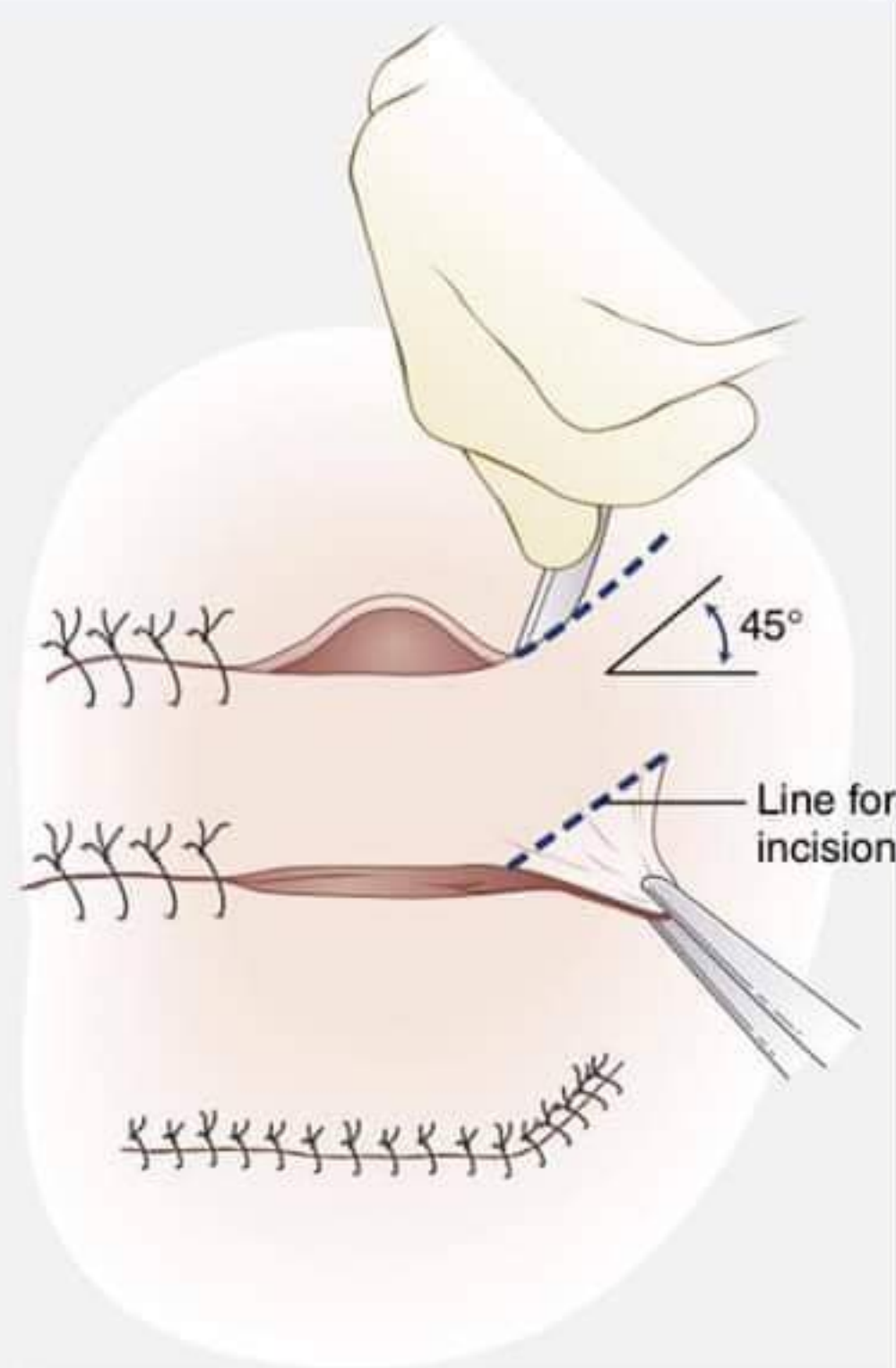
PROCEDURE**CORRECTING DOG EAR DEFORMITY**

If a dog ear develops, the sutures should be removed and the closure reattempted. If it appears that correction cannot be achieved by reapproximation, the following method illustrates an acceptable procedure for correction.

1. Make an incision 45 degrees at the end of the redundant side.

NOTE: This tissue is undermined to create a small flap, which when gentle traction is applied can be excised as shown.

2. Close the wound in the usual fashion, creating a "hockey-stick" appearance (Figure 23-8).



Sun Bunlorn, MD-Medical Knowledges page

FIGURE 23-8 (Modified from Trott AT. Wounds and Lacerations: Emergency Care and Closure, ed 2. St. Louis: Mosby-Year Book; 1998, p 37.)

PROCEDURE

PERFORMING THE VERTICAL MATTRESS ("FAR-FAR/NEAR-NEAR") STITCH

The next most commonly performed stitch is the vertical mattress stitch. This stitch is so named because the stitch lies in a plane perpendicular (vertical) to the skin. It is useful for closing deeper wounds (e.g., those of the scalp) in which the closure occurs at two levels (superficial and deep), eliminating dead space.

1. To perform the vertical mattress stitch, introduce the needle "far" and exit "far" from the

wound edge, diving deep but just superficial to the wound depth (Figure 23-9).

NOTE: Figure 23-9 illustrates a wound with first stitch traversing the lower wound margin. Most wounds will have the first stitch traverse within the lower portion of the wound margin, as illustrated in Figure 23-6.

2. Next, starting on the same side as the first exit point, load the needle backhand (needle points to dominant shoulder while all other criteria remain unchanged) and enter "near" the wound edge and exit on the

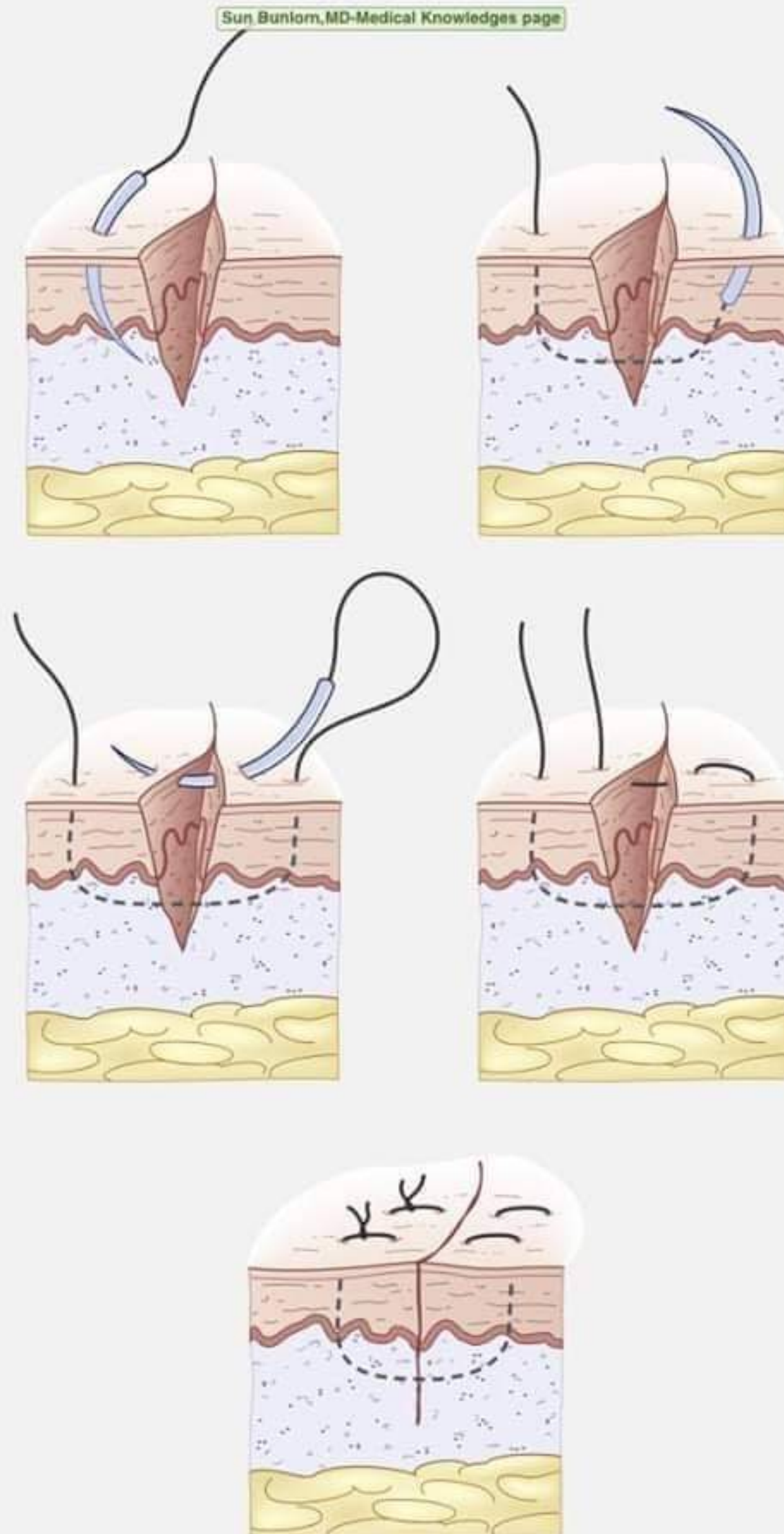


FIGURE 23-9 (Modified from Trott AT. Wounds and Lacerations: Emergency Care and Closure, ed 2. St. Louis: Mosby-Year Book; 1998, p 38.)

original side "near" the wound edge, both at a level more superficial than the original deep first pass.

3. The remainder of the instrument tying steps is the same (see Figure 23-7).

NOTE: Performing the second step first, or a "near-near/far-far" stitch, should be avoided to eliminate "blind" needle placement and creating inadvertent trauma to unseen structures.

PROCEDURE

PERFORMING THE HORIZONTAL MATTRESS STITCH

The horizontal mattress stitch lies in a plane parallel to the skin.

1. To perform the horizontal mattress stitch, start on the vascular side and exit on the relatively avascular side.
2. Reenter backhanded on this avascular side parallel to the wound edge and adjacent to

the original exit site; the final exit is on the original vascular side.

NOTE: The stitch should look like a box. All knot tying steps are performed as previously discussed except that the stitch is brought down parallel (not perpendicular) to the wound line (Figure 23-10).

Sun Bunlorn, MD-Medical Knowledges page

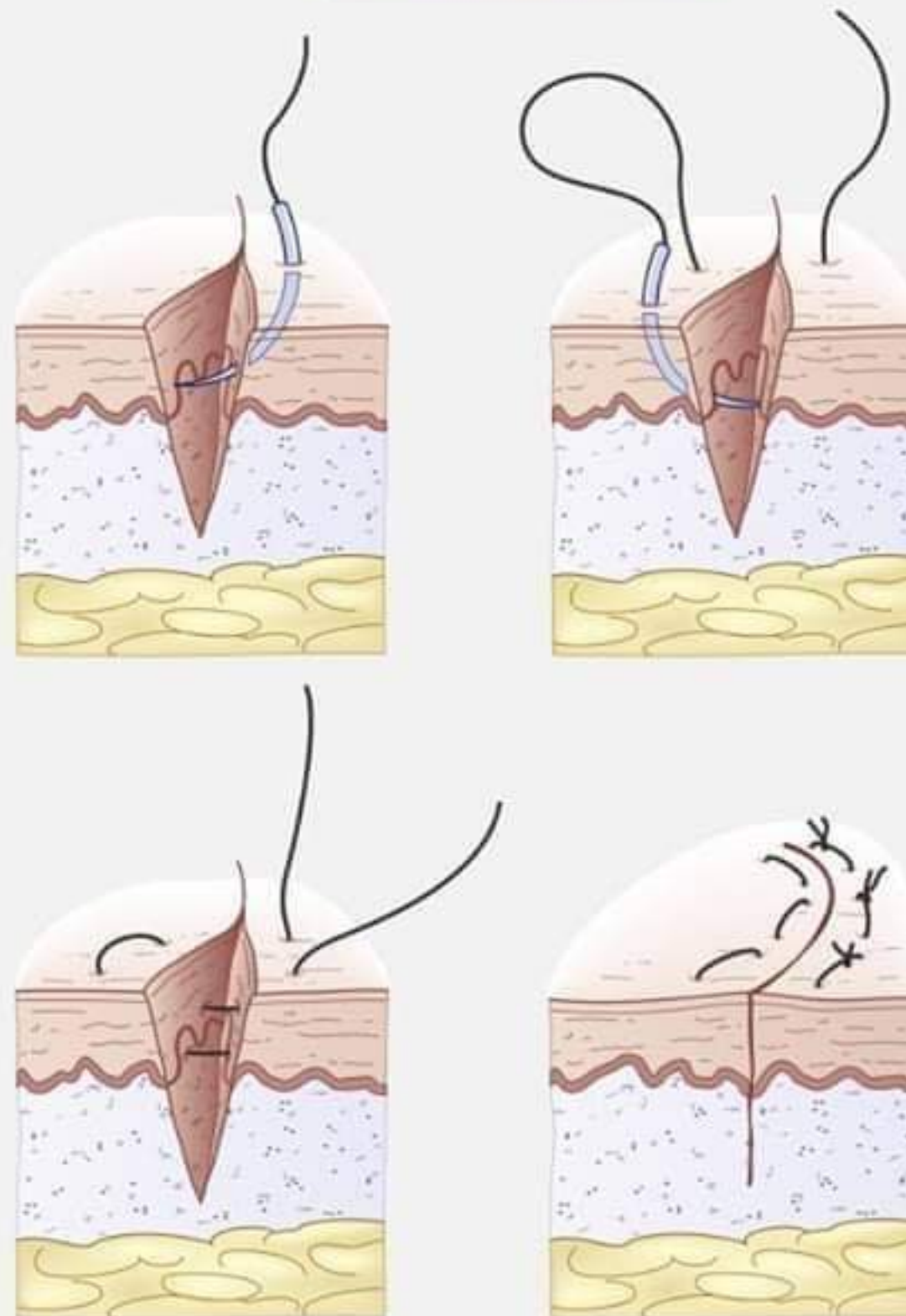


FIGURE 23-10 (Modified from Trott AT. Wounds and Lacerations: Emergency Care and Closure, ed 2. St. Louis: Mosby-Year Book; 1998, p 39.)

The horizontal mattress stitch is useful when there is a flap of tissue or when the tension of the stitch is to be predominantly on one side (the knotted side). For example, this method works well in a wound with a vascular side and a relatively avascular side, as the avascular area is pulled toward the vascular side, with most of the tension being on the vascular side. In other stitch types, the tension is shared equally by each side.

PROCEDURE

PERFORMING THE CONTINUOUS-RUNNING-BASEBALL STITCH

The advantages of the continuous stitch is that it can be performed quickly and can be applied tightly if "locked." The disadvantages are as follows:

- If one loop is broken, the entire wound may open.
- It cannot be partially removed as can other stitch types (e.g., every other or a wound segment) to allow for drainage when managing an early wound infection.
- It may leave a cosmetically suboptimal scar with a "railroad tracks" appearance.

The continuous suture is performed as follows:

1. Place a suture at the end of the wound in the same fashion as that outlined for a simple interrupted suture (only cut suture on nonneedle side after knot is tied).
2. Using the initial suture as an anchor, additional sutures are placed (throws) in a continuous fashion until the entire wound is reapproximated. Enter next to knot and exit on opposite side skin surface at a 45-degree angle to the wound and reenter through skin surface directly across and repeat (Figure 23-11).

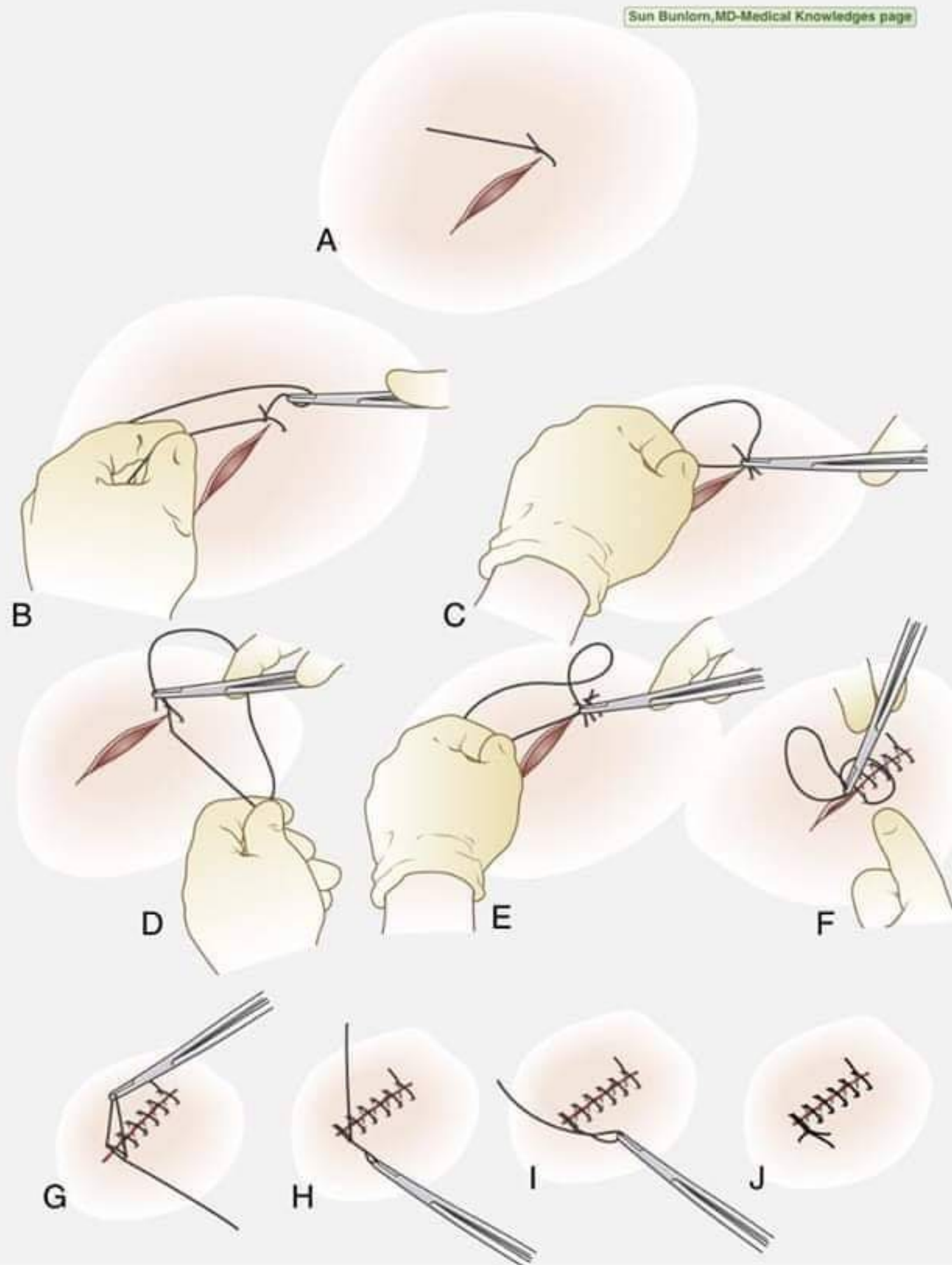


FIGURE 23-11 (Modified from Trott AT: *Wounds and Lacerations: Emergency Care and Closure*, ed 2. St. Louis, Mosby-Year Book, 1998, pp 123-128.)

3. When the end of the wound is reached, the final suture is tied in the same manner as that outlined for the simple interrupted suture, but the needle side is tied to the last loop before it has been pulled taut. When cut, it will yield three tails.

NOTE: The method illustrated demonstrates the “nonlocking” method. To “lock” the suture, bring the needle up through the previous loop before it has been pulled taut, creating a tight seal; this can be particularly useful intraoperatively.

PROCEDURE

PERFORMING THE SUBCUTICULAR STITCH

The subcuticular stitch is often used to close a surgical incision or a very clean wound. Absorbable suture material must be used if the suture will not be removed at a later time.

1. Create an initial buried knot to anchor the suture (Figure 23-12).
2. Begin making equal passes through the wound edges in the horizontal plane until you have traversed the length of the wound (entering and exiting the dermal layer from side to side).

NOTE: It is important to keep the bites equal and approximate the tissue so that it aligns properly.

3. A final buried knot is tied at the opposite wound end to complete and anchor the opposite end of the suture. Leave the needle side of the suture tail uncut (cut the loop side).

NOTE: The suture is secure because of the final buried anchor knot.

4. Bury the final tail by reentering the closed wound with the needle and attached suture and exiting on the skin surface 1 cm away from the wound edge.
5. Cut it flush with the skin.
6. Apply skin tapes over the wound surface.

NOTE: No suture will be visible on the skin surface.

Sun Bunlorn, MD-Medical Knowledges page

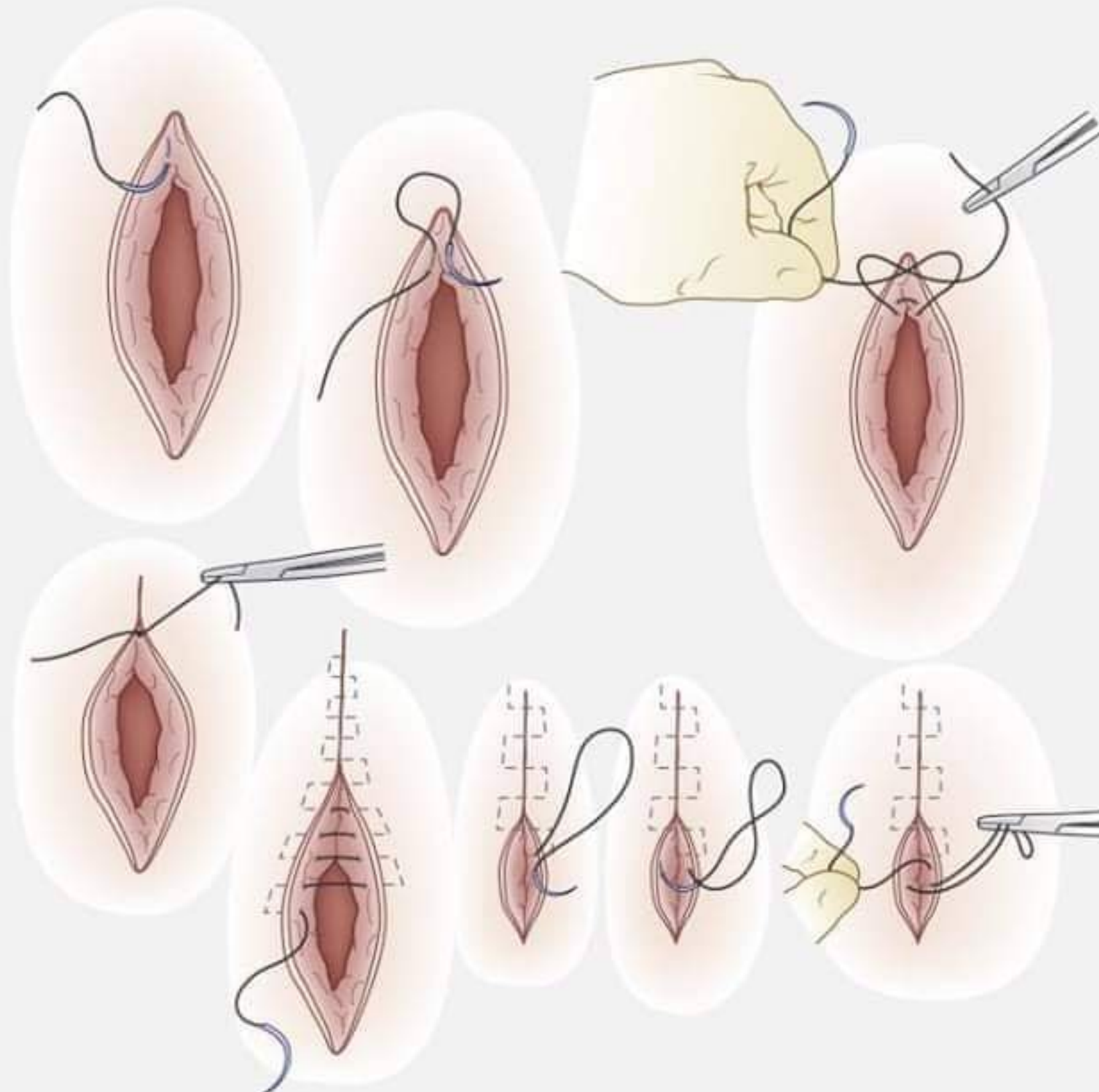
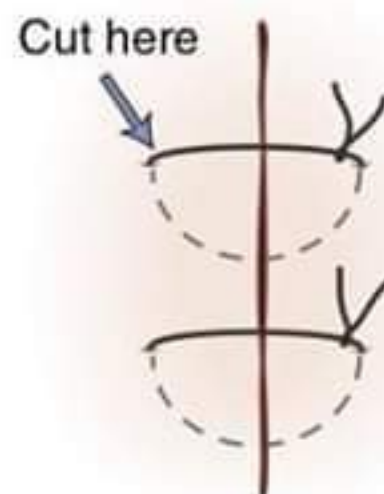


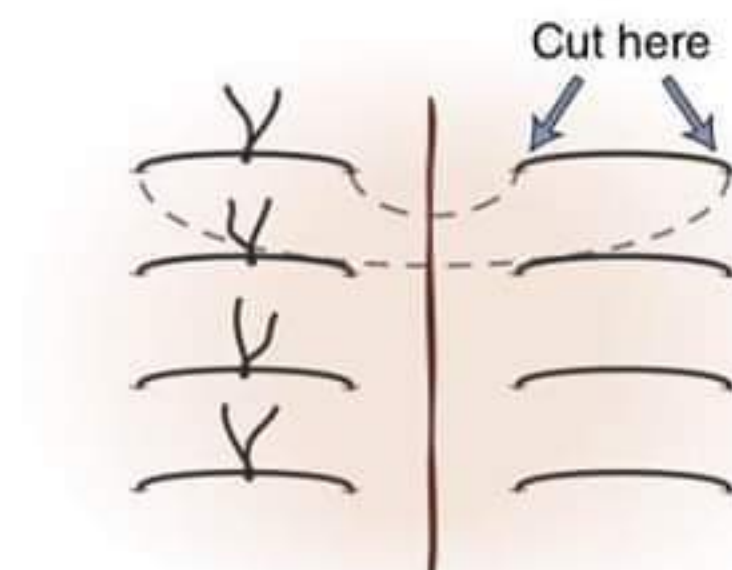
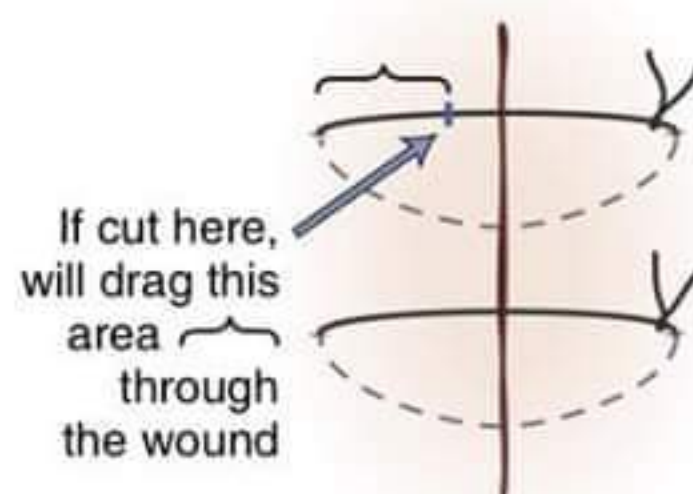
FIGURE 23-12 (Modified from Trott AT. Wounds and Lacerations: Emergency Care and Closure, ed 2. St. Louis: Mosby-Year Book; 1998, p 41.)

Suture removal

Example of
correct removal



Example of
incorrect removal



Sun Bunlorn, MD-Medical Knowledges page

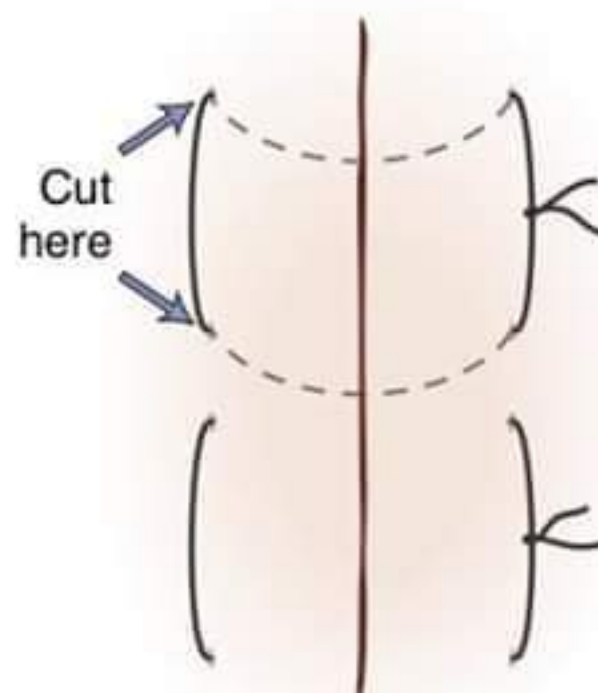


FIGURE 23-13 Suture removal.

CHAPTER 23 Wound Closure

TABLE 23-3 Suggested Guidelines for Suture Material and Size for 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‡
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	—

*Nonabsorbable monofilaments include nylon (Ethilon, Dermalon), polypropylene (Prolene), and polybutester (Novafil).

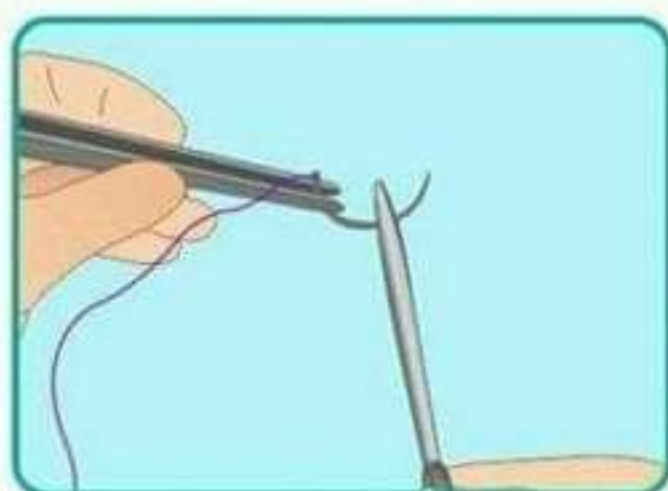
†Absorbable materials for dermal and fascial closures include polyglycolic acid (Dexon, Dexon Plus), polyglactin 910 (Vicryl), polydioxanone (PDS [monofilament absorbable]), and polyglyconate (Maxon [monofilament absorbable]).

‡Absorbable materials for mucosal and scrotal closure include chromic gut and polyglactin 910 (Vicryl).

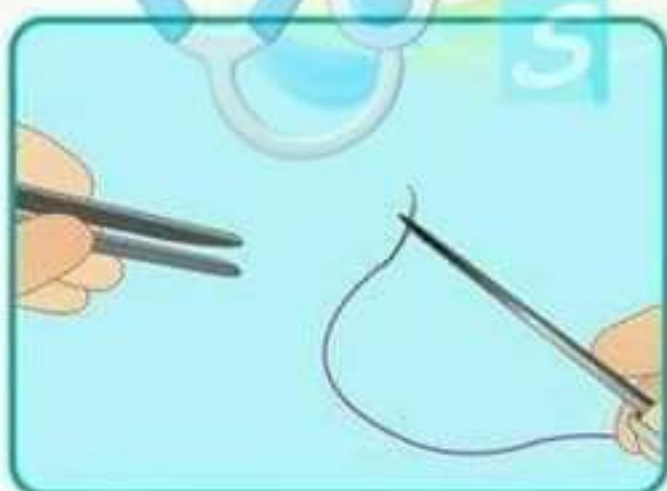
Modified from Trott AT. *Wounds and Lacerations: Emergency Care and Closure*. 2nd ed. St. Louis, MO: Mosby-Year Book; 1998:179.

SUTURING TECHNIQUES

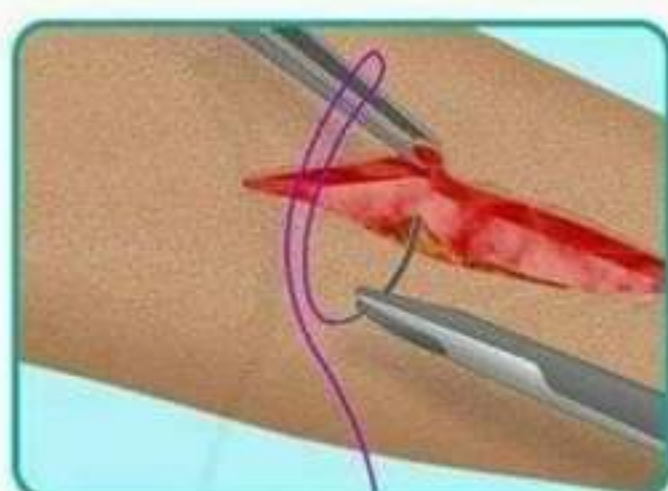
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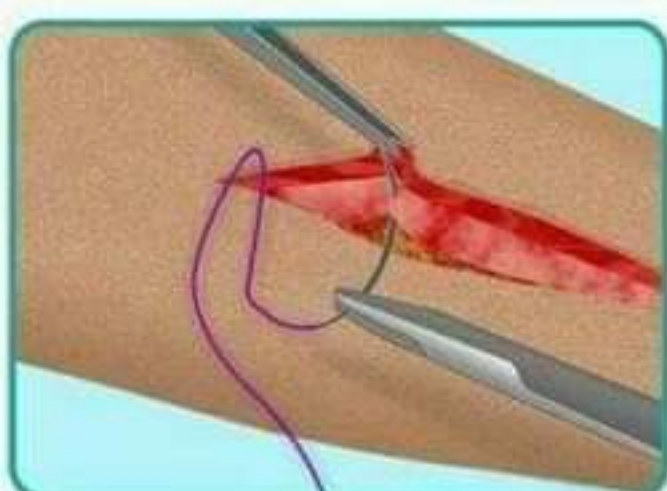
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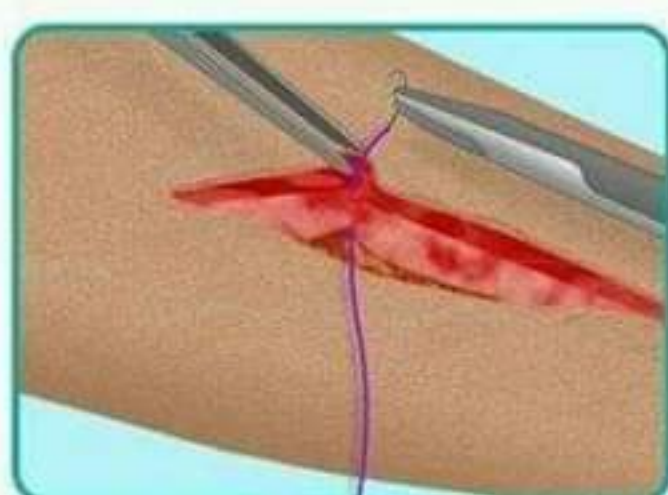
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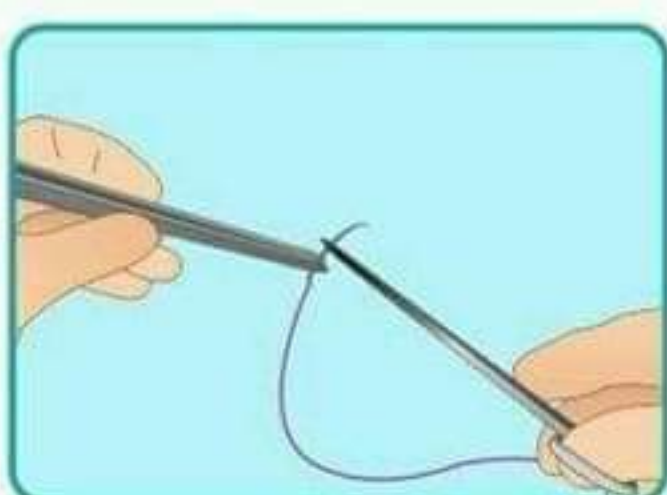
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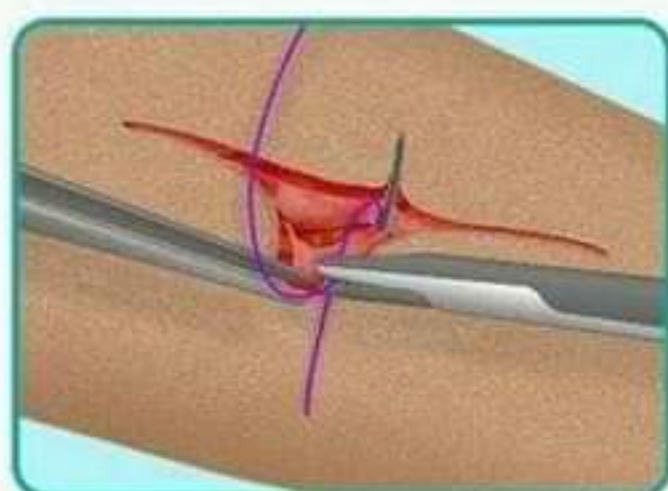
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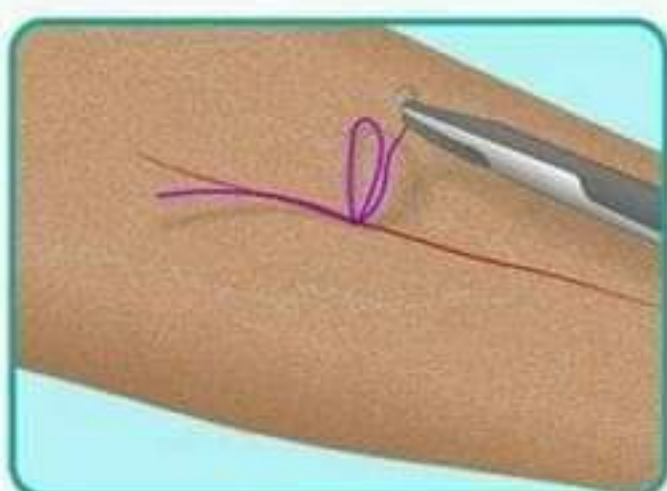
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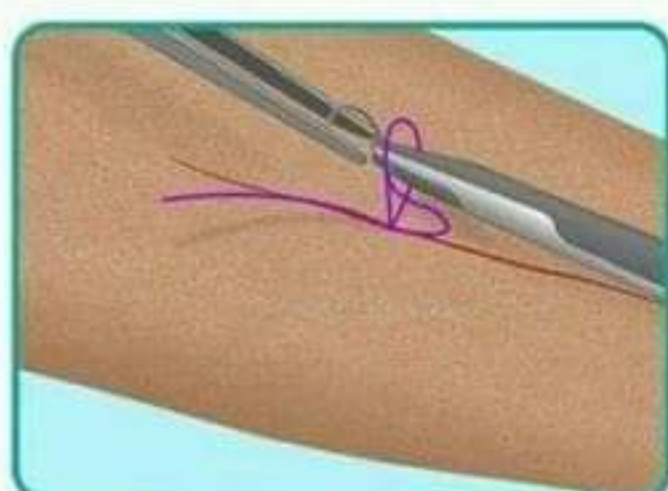
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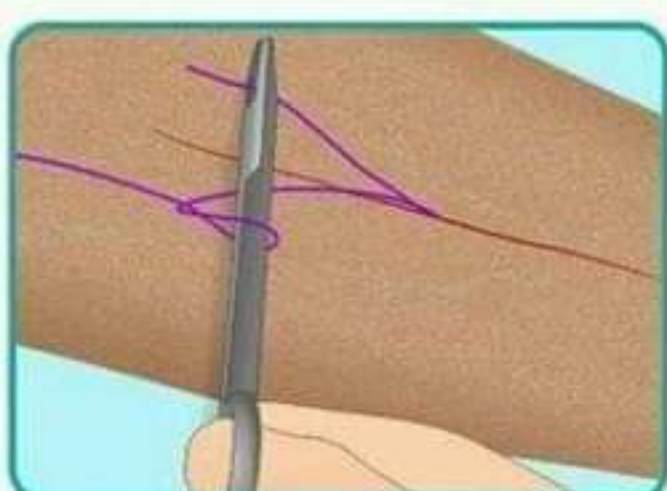
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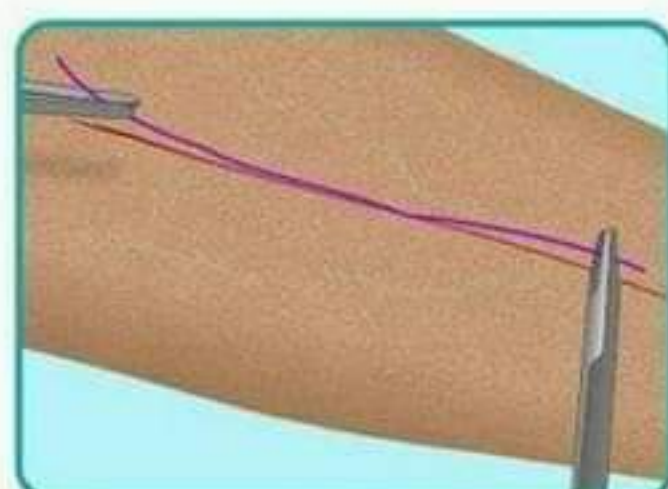
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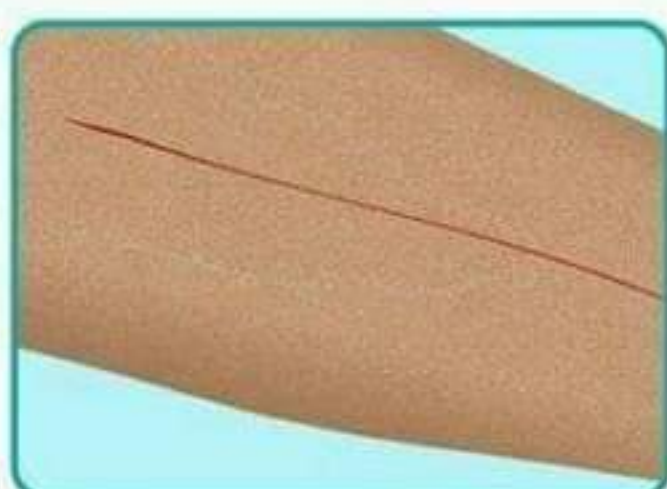
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STEP 10

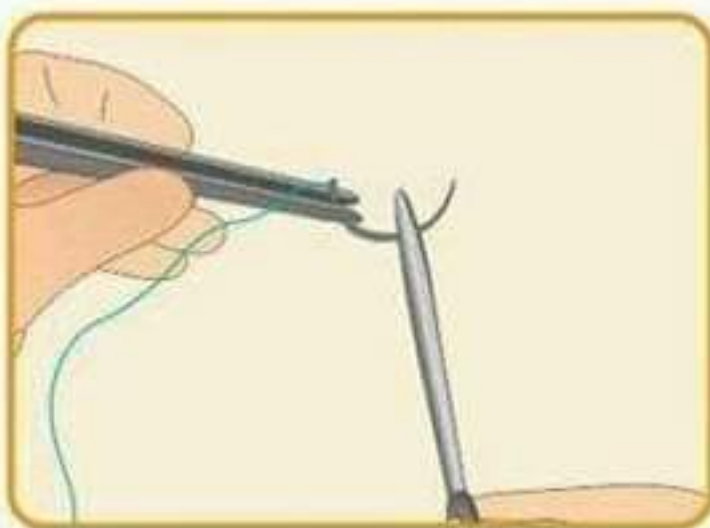


STEP 11



STEP 12

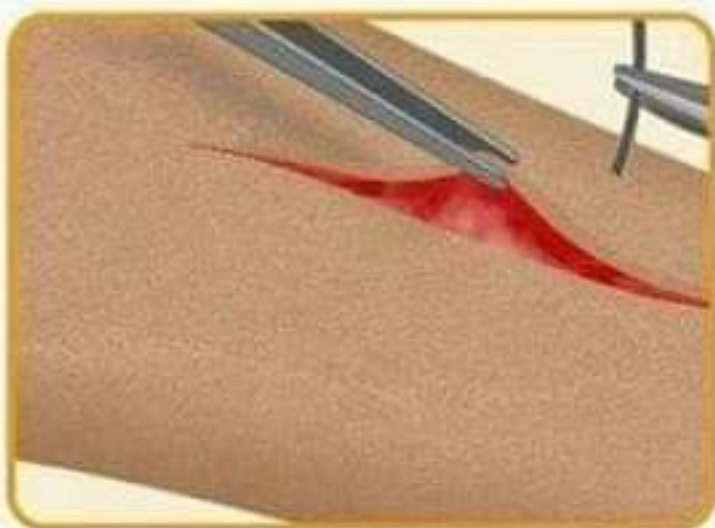
2. Interrupted Sutures



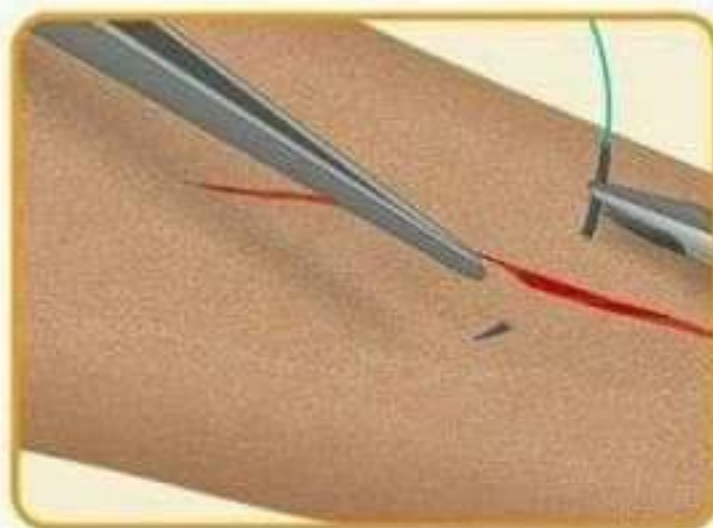
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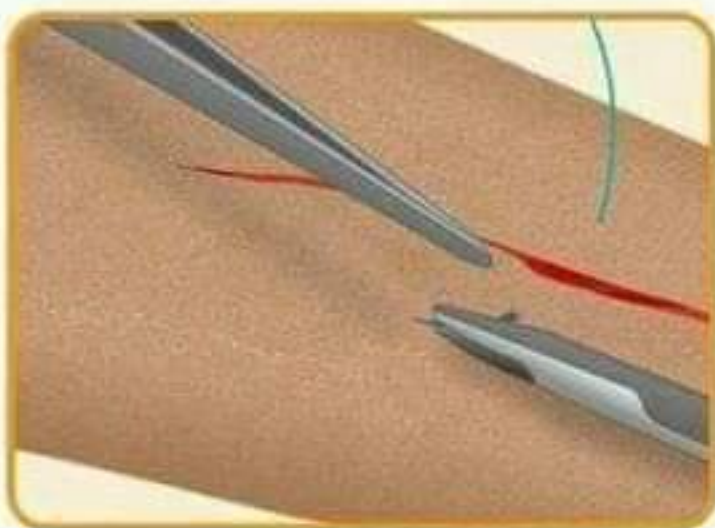
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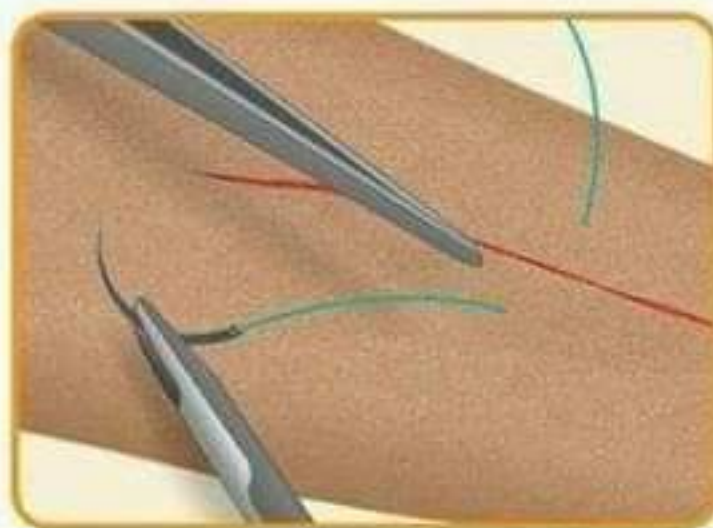
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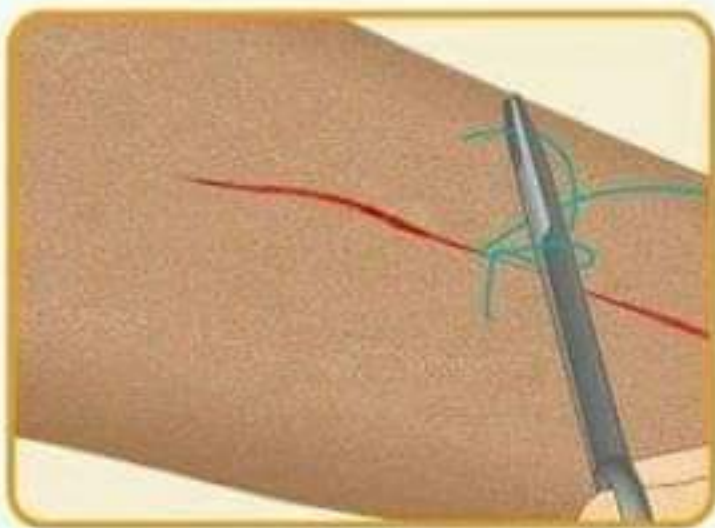
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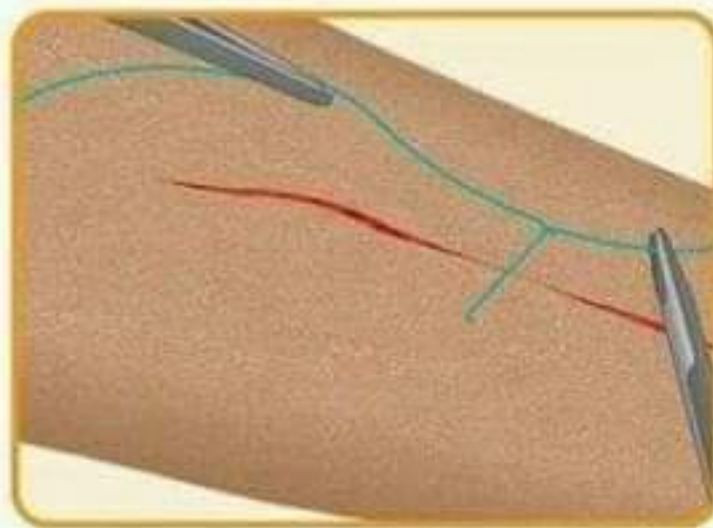
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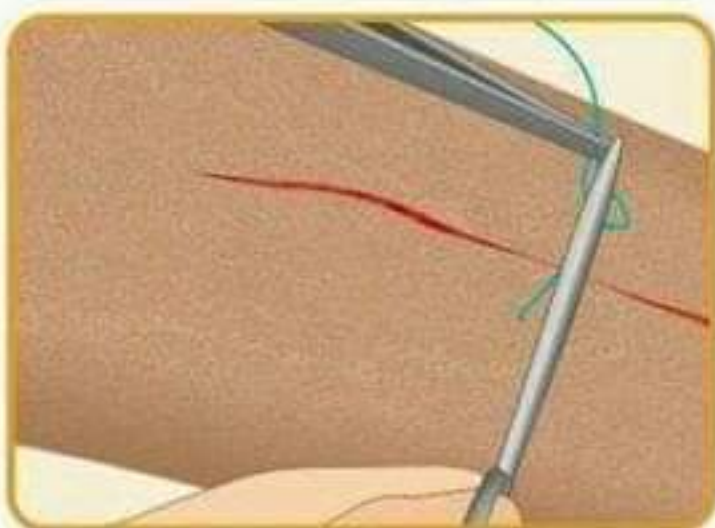
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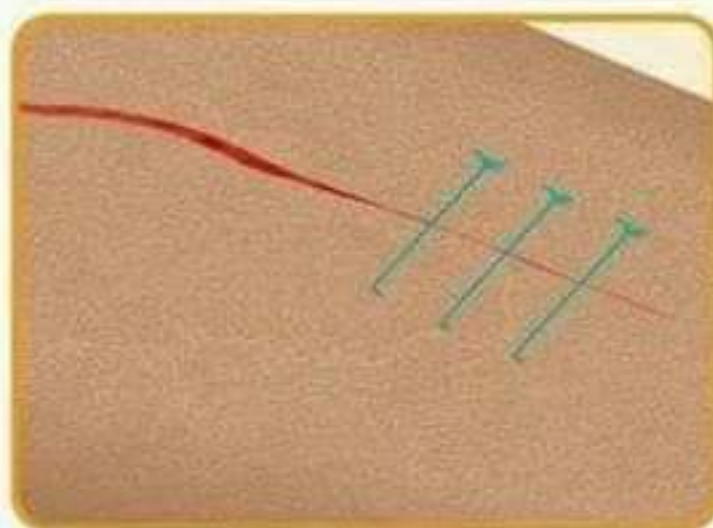
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SUTURING TECHNIQUES

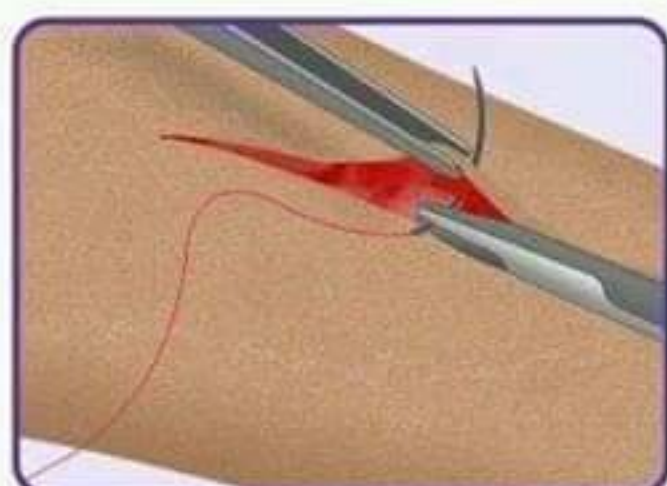
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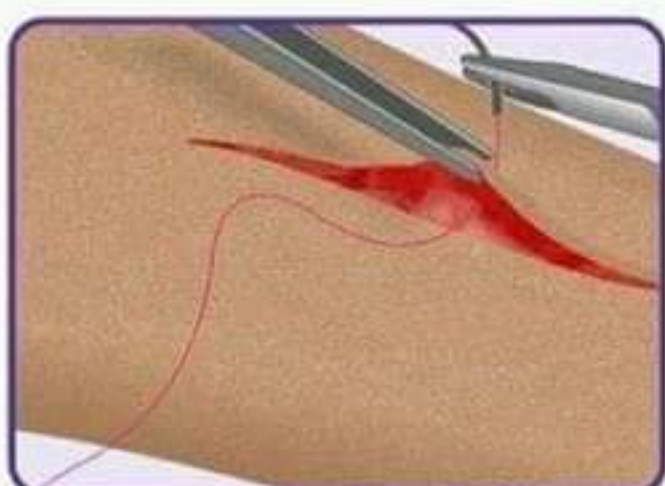
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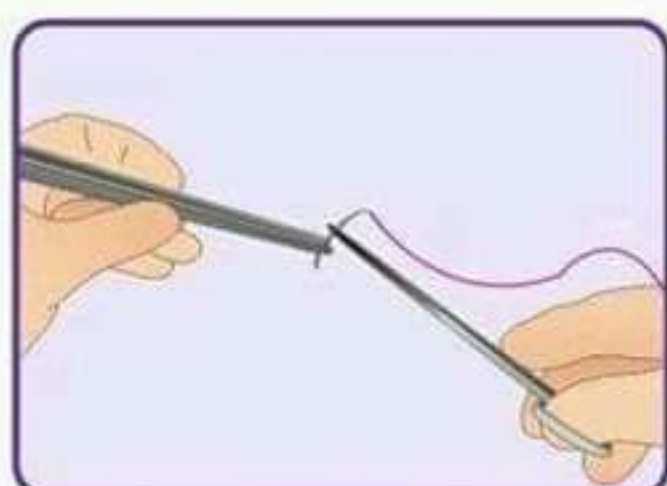
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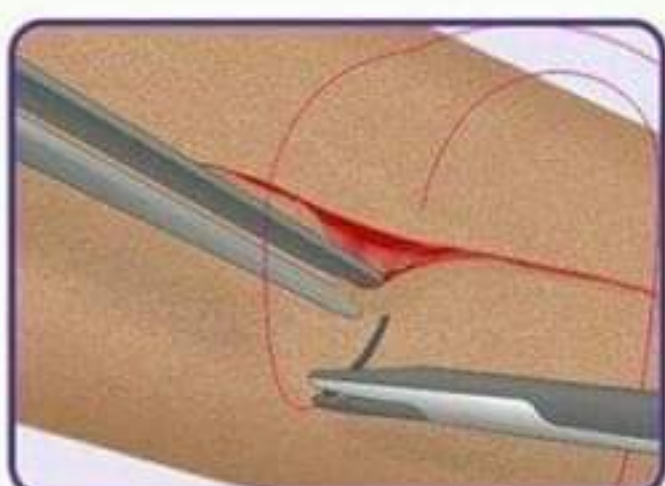
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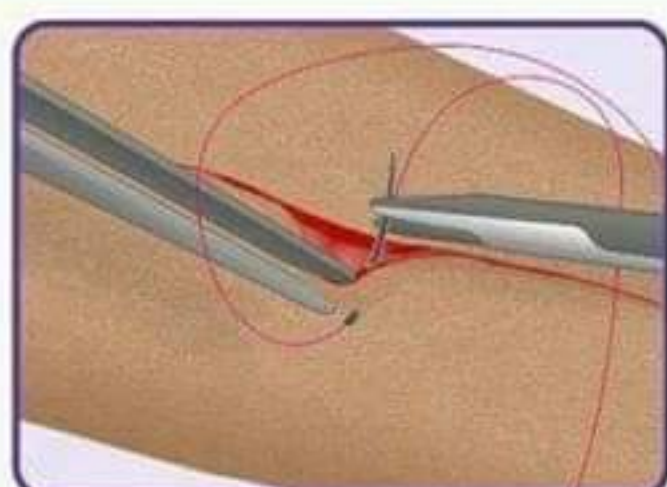
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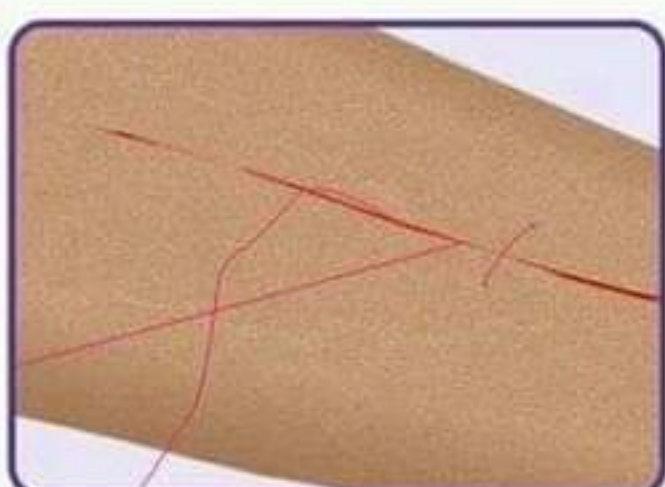
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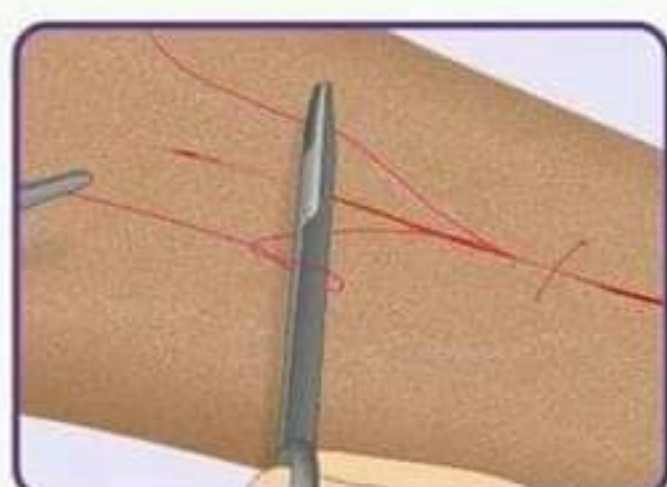
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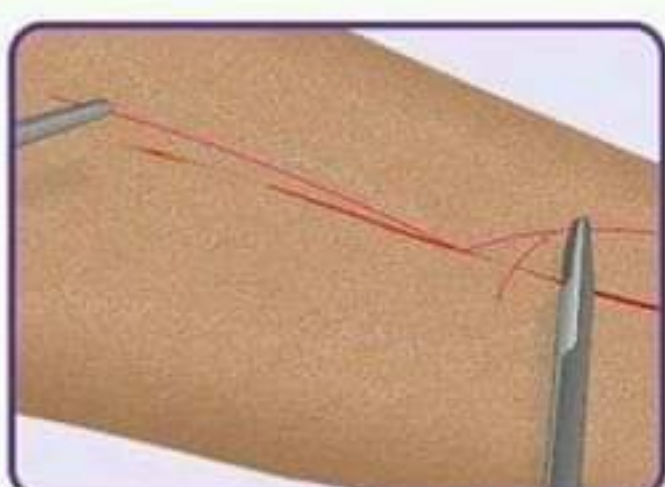
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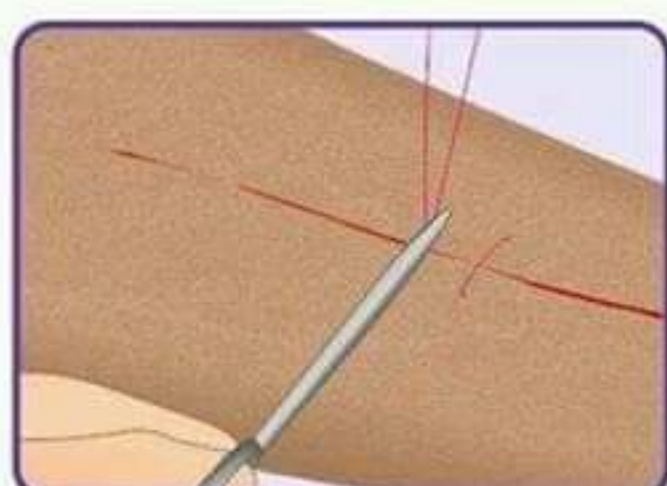
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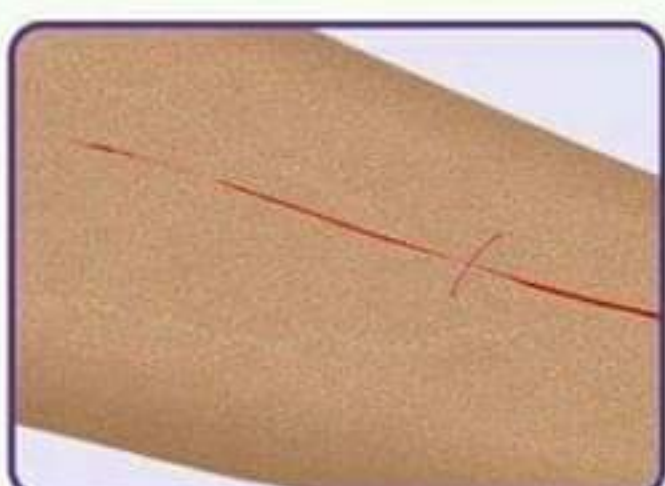
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STEP 10



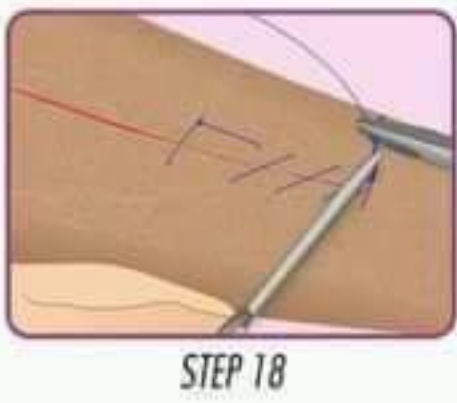
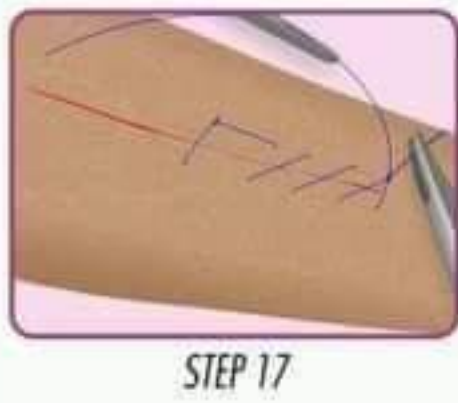
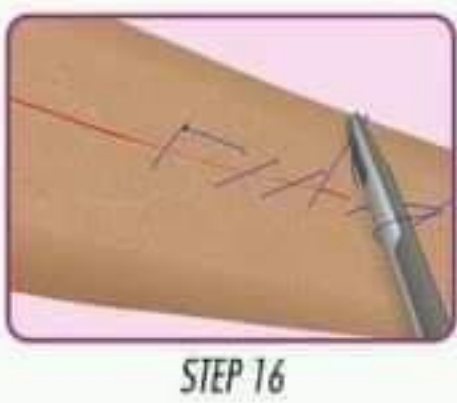
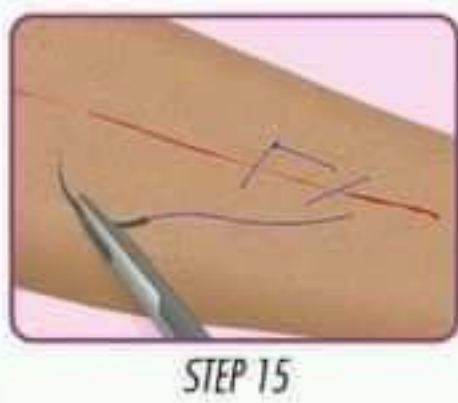
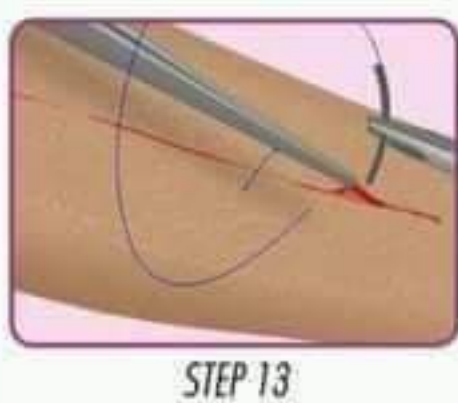
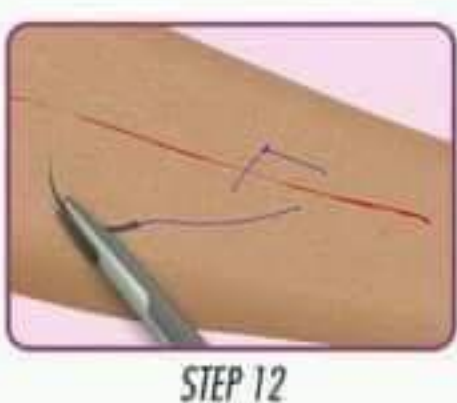
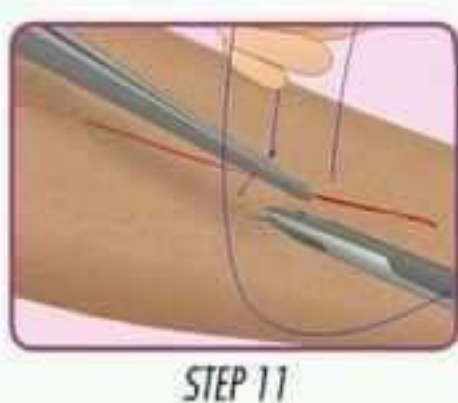
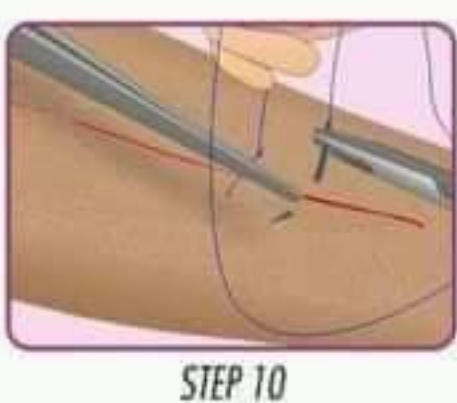
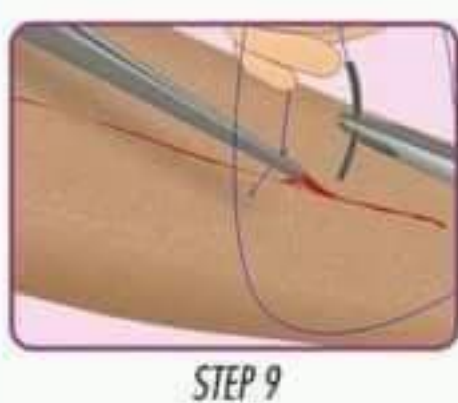
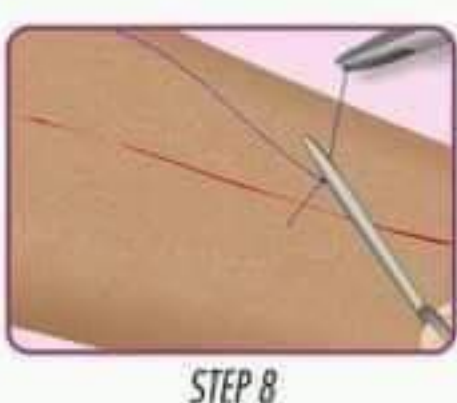
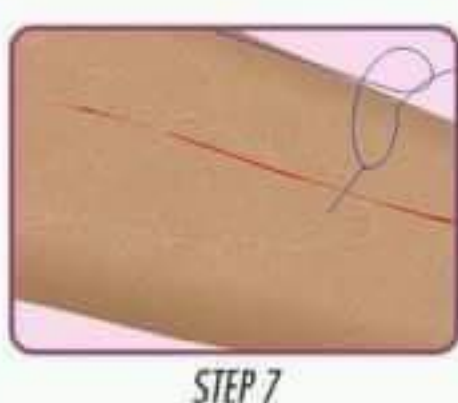
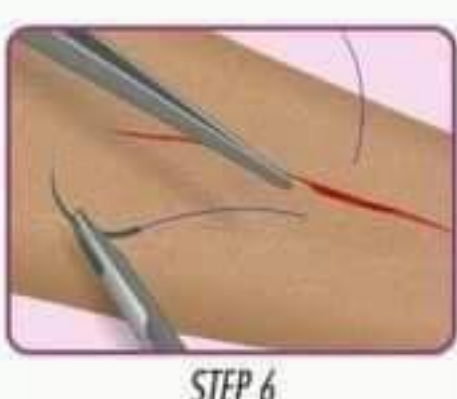
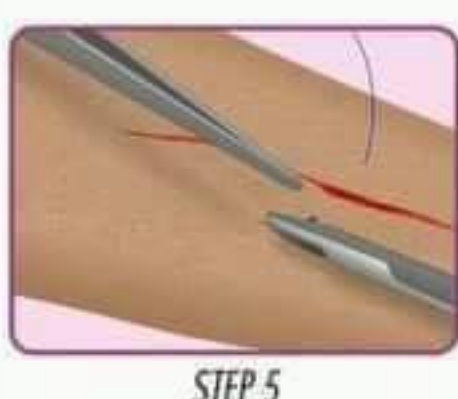
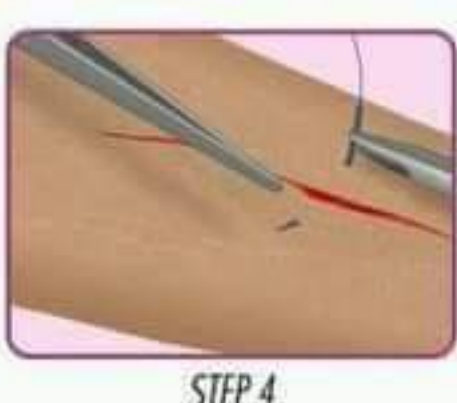
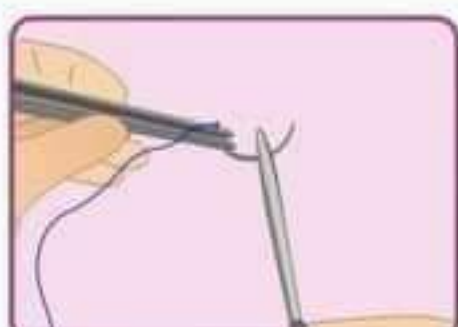
STEP 11



STEP 12

SUTURING TECHNIQUES

4. Continuous Sutures



SUTURING TECHNIQUES

5. Continuous Interlocking Sutures



STEP 1



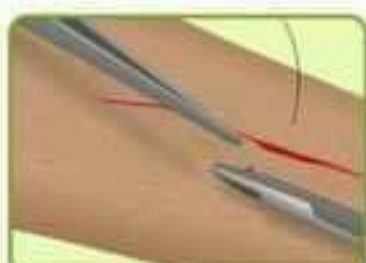
STEP 2



STEP 3



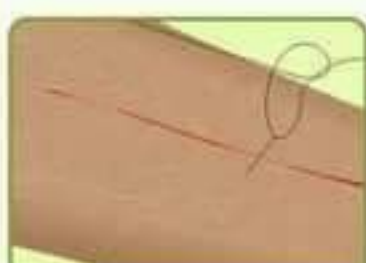
STEP 4



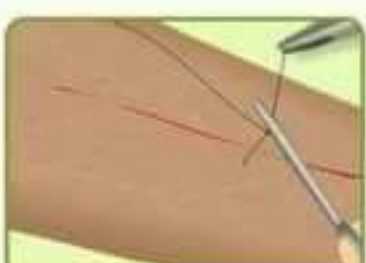
STEP 5



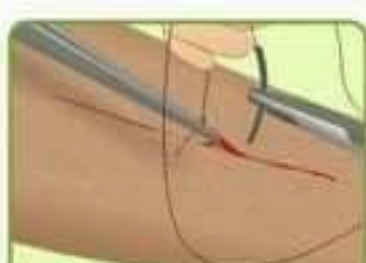
STEP 6



STEP 7



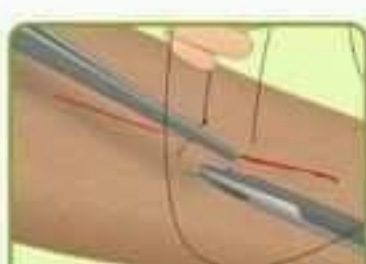
STEP 8



STEP 9



STEP 10



STEP 11



STEP 12



STEP 13



STEP 14



STEP 15



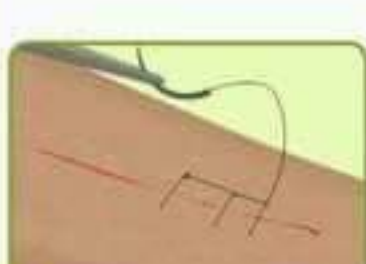
STEP 16



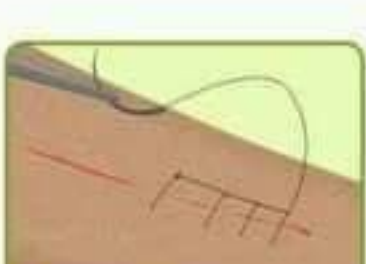
STEP 17



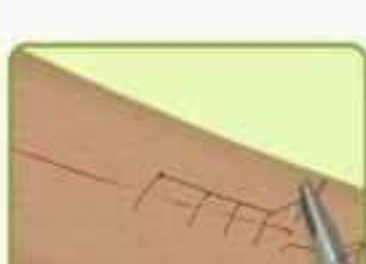
STEP 18



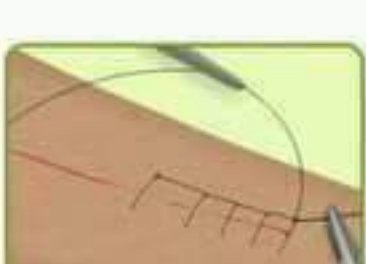
STEP 19



STEP 20



STEP 21



STEP 22



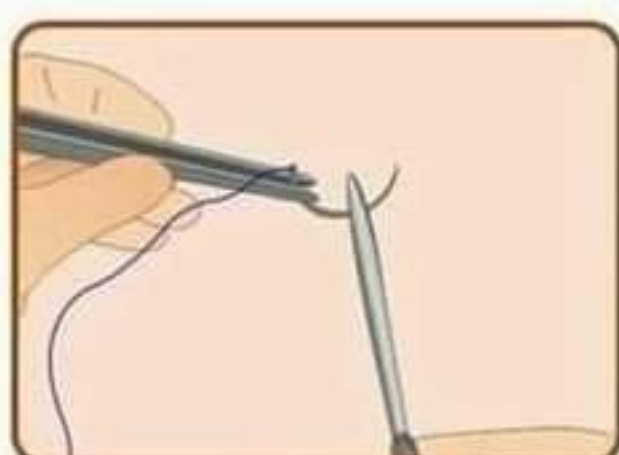
STEP 23



STEP 24

SUTURING TECHNIQUES

6. Horizontal Mattress Sutures



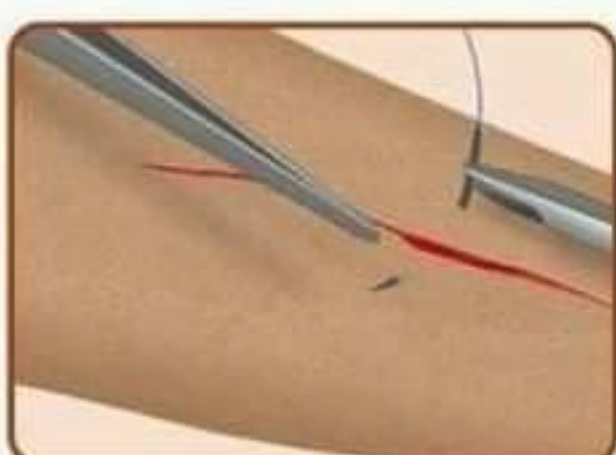
STEP 1



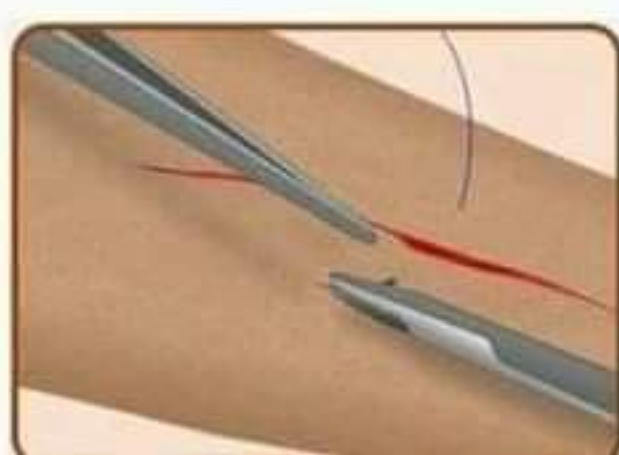
STEP 2



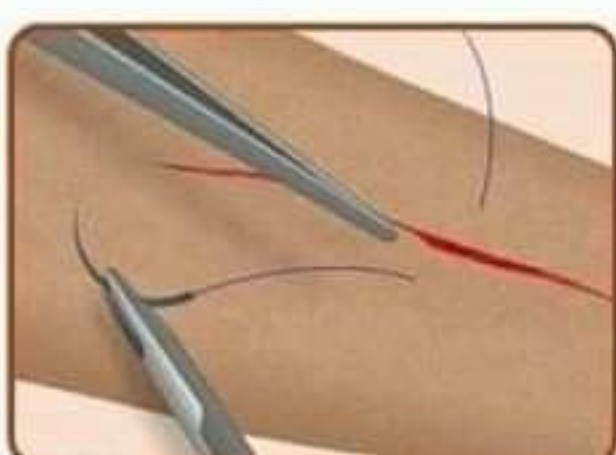
STEP 3



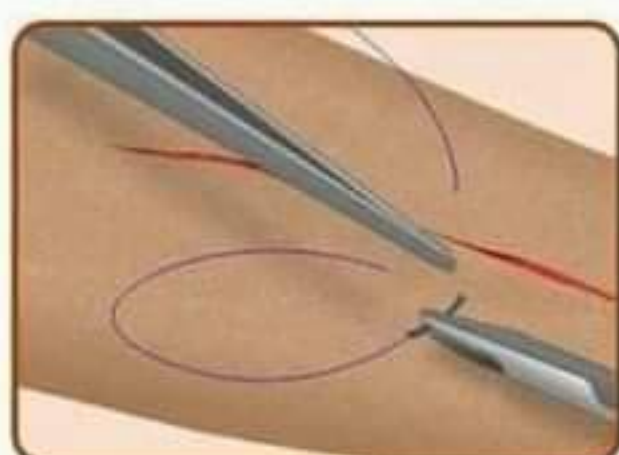
STEP 4



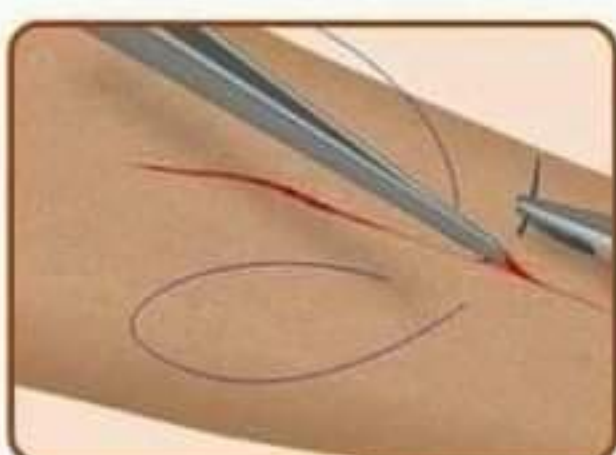
STEP 5



STEP 6



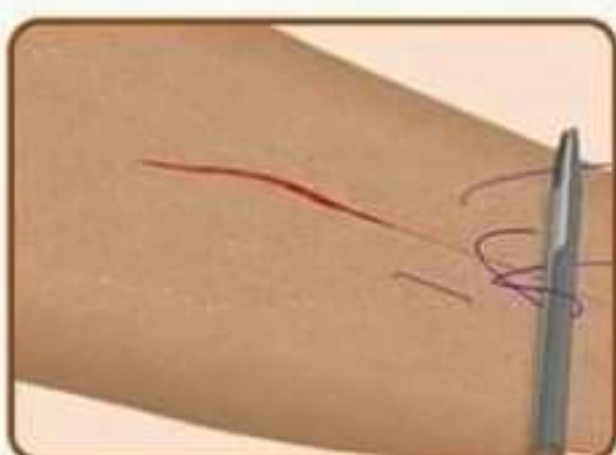
STEP 7



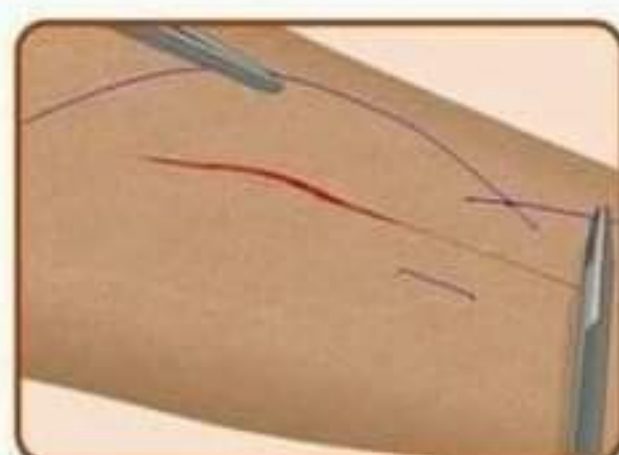
STEP 8



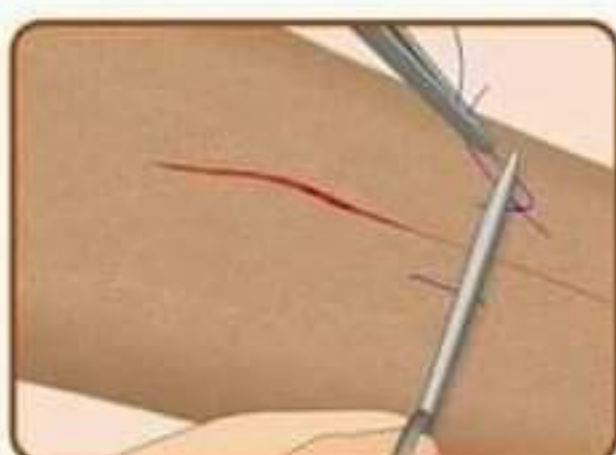
STEP 9



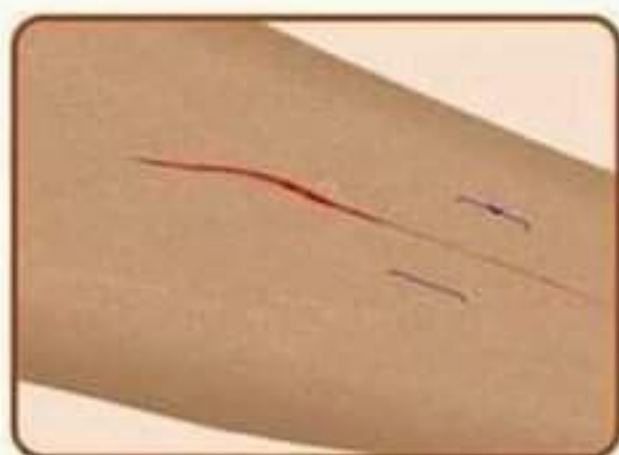
STEP 10



STEP 11



STEP 12



STEP 13

SUTURING TECHNIQUES

7. Vertical Mattress Sutures



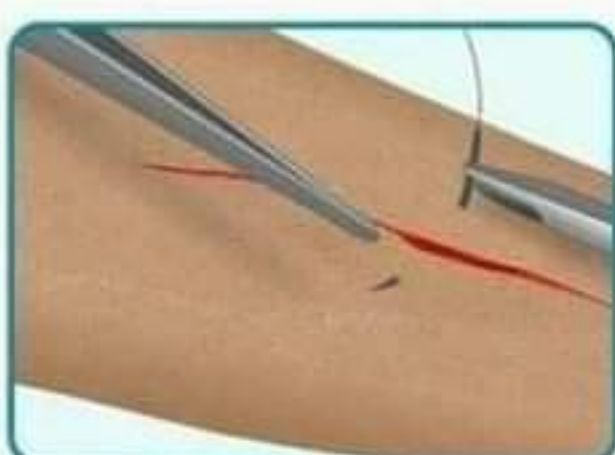
STEP 1



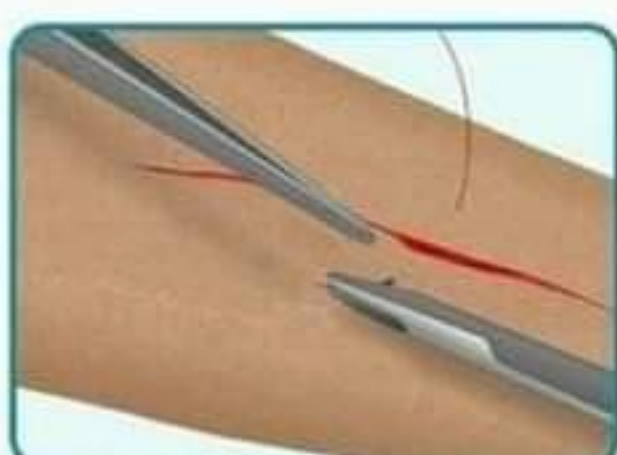
STEP 2



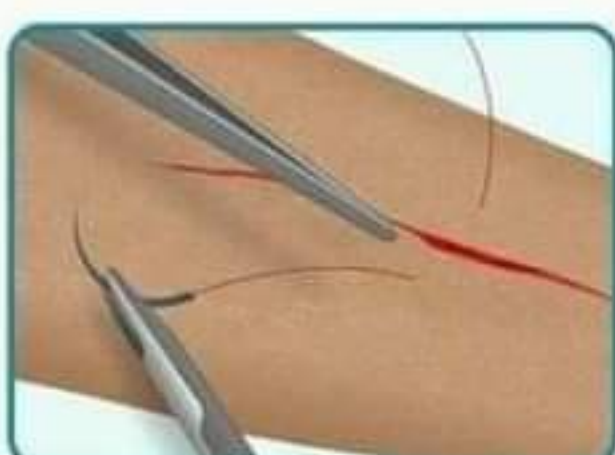
STEP 3



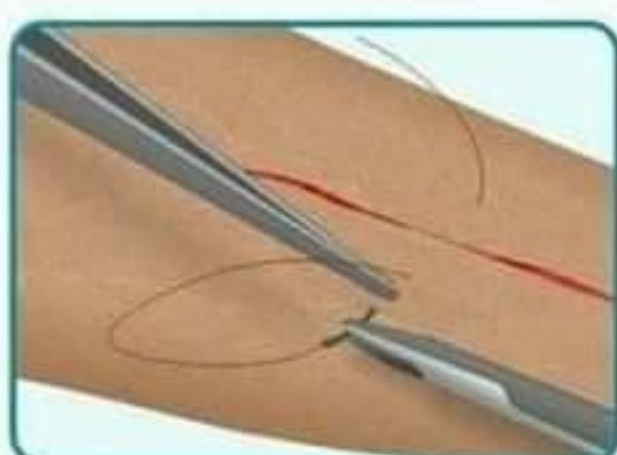
STEP 4



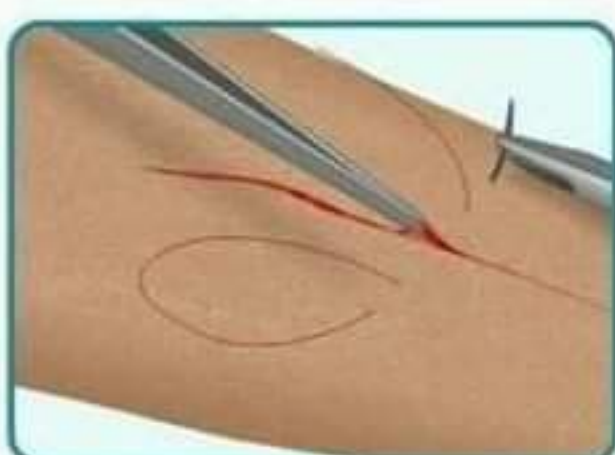
STEP 5



STEP 6



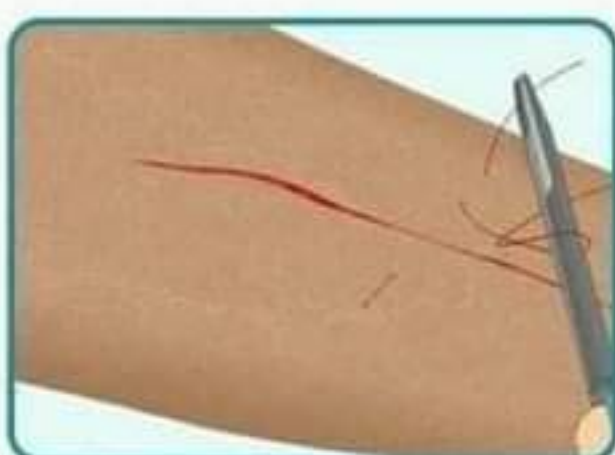
STEP 7



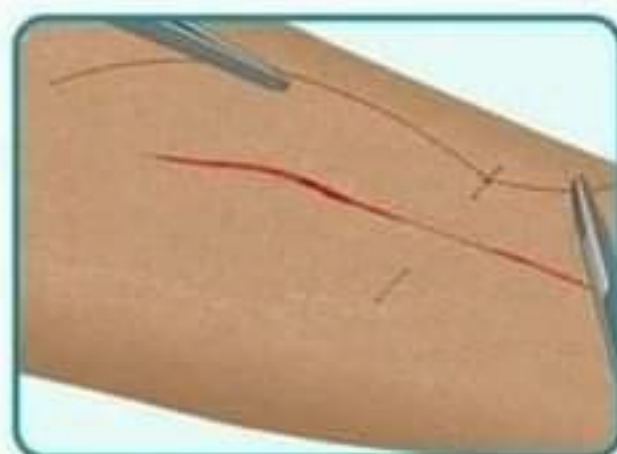
STEP 8



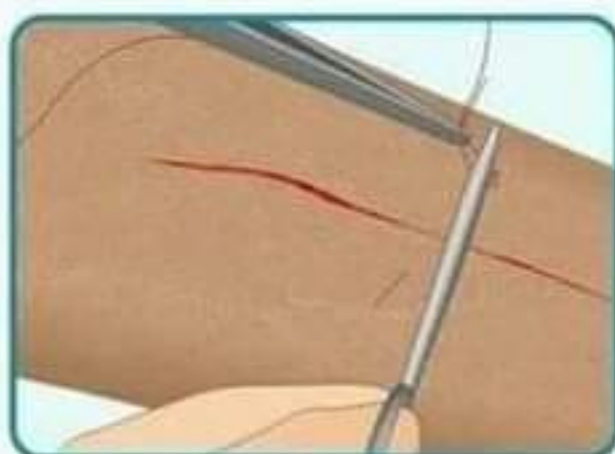
STEP 9



STEP 10



STEP 11



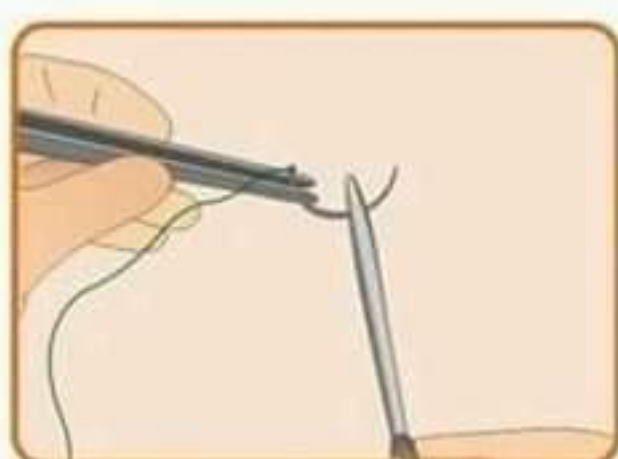
STEP 12



STEP 13

SUTURING TECHNIQUES

8. "Far-And-Near" Sutures



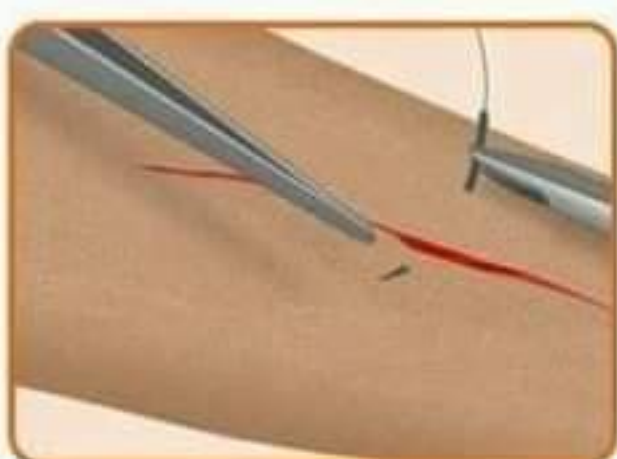
STEP 1



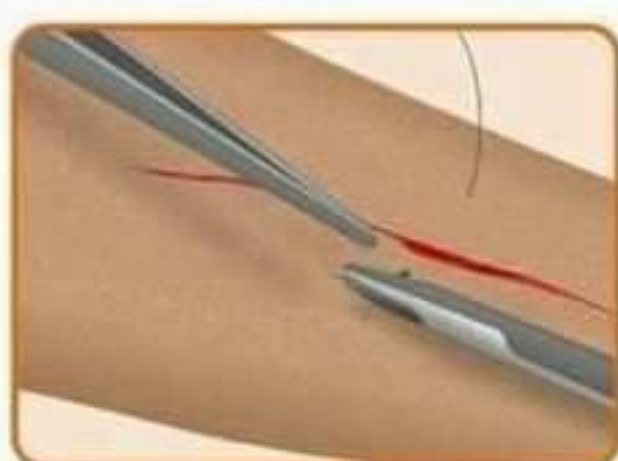
STEP 2



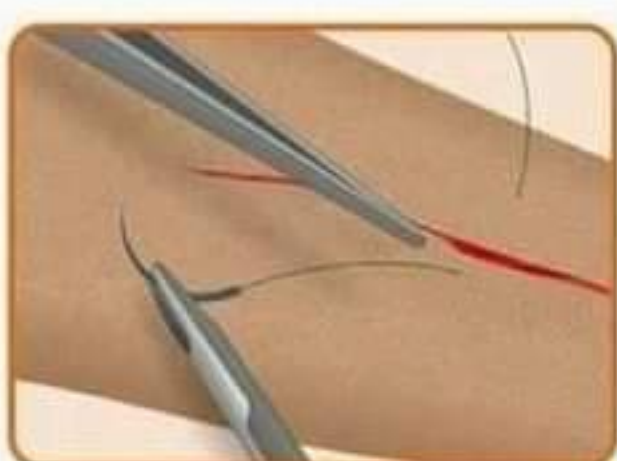
STEP 3



STEP 4



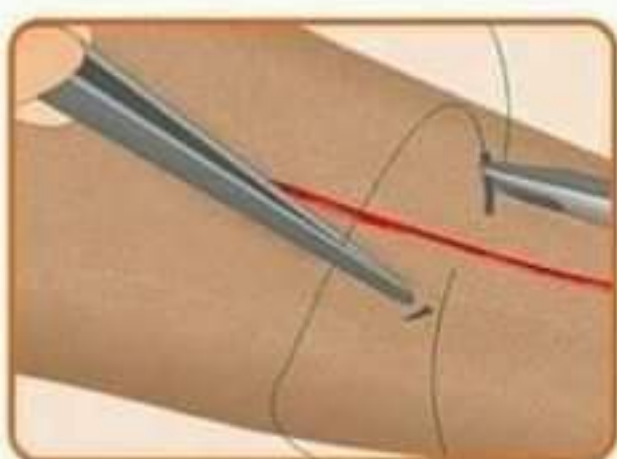
STEP 5



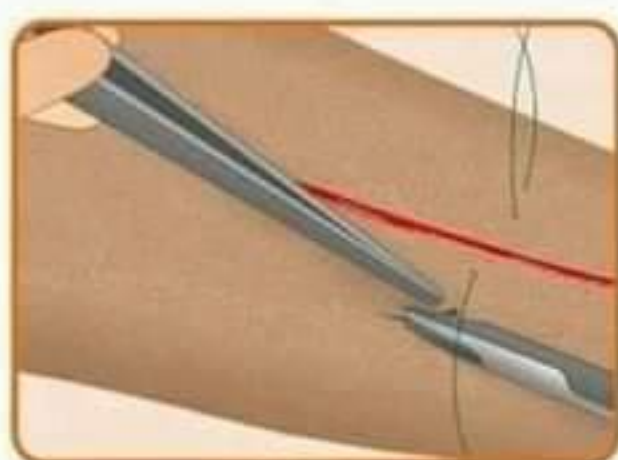
STEP 6



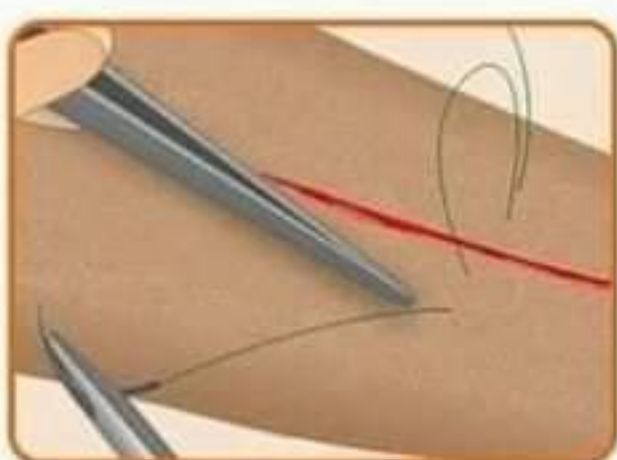
STEP 7



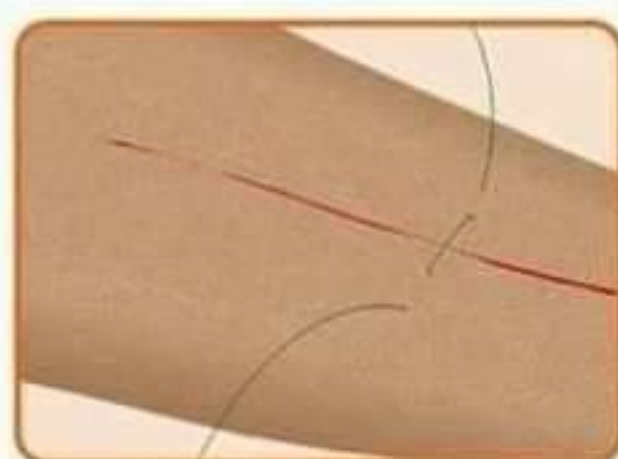
STEP 8



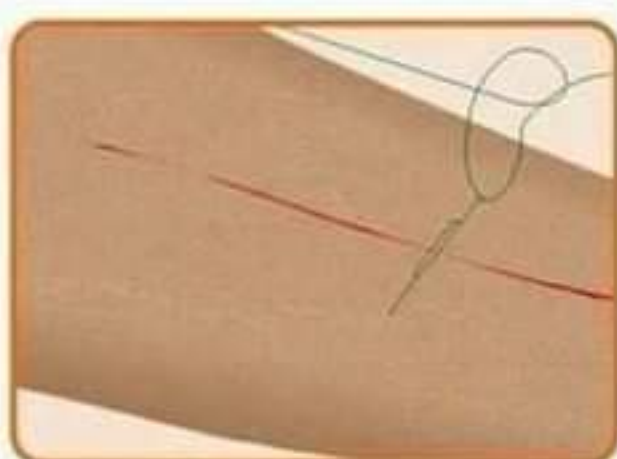
STEP 9



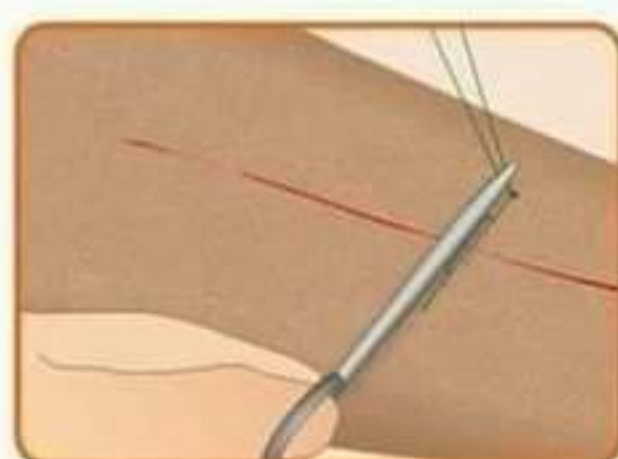
STEP 10



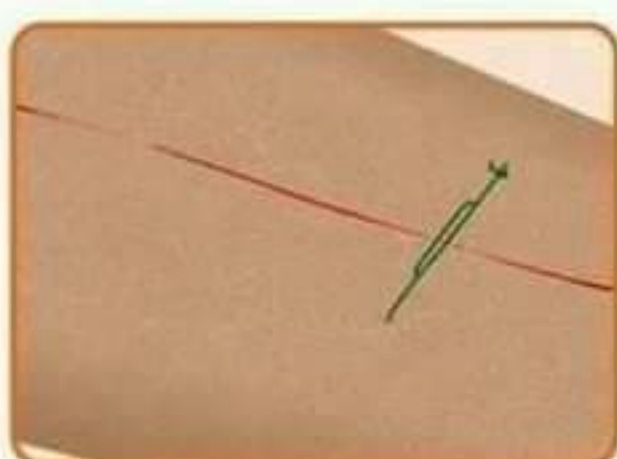
STEP 11



STEP 12



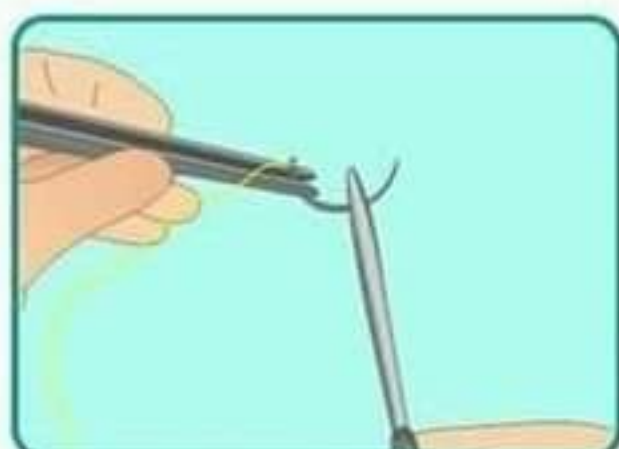
STEP 13



STEP 14

SUTURING TECHNIQUES

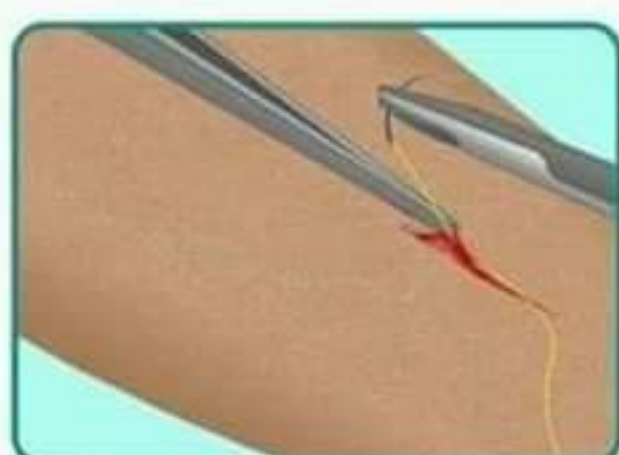
9. Subcuticular Sutures



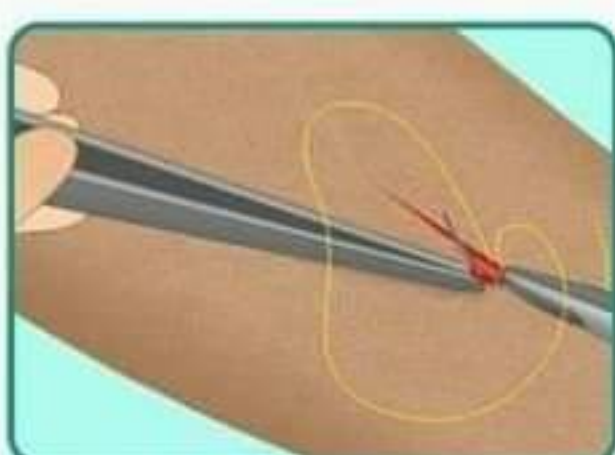
STEP 1



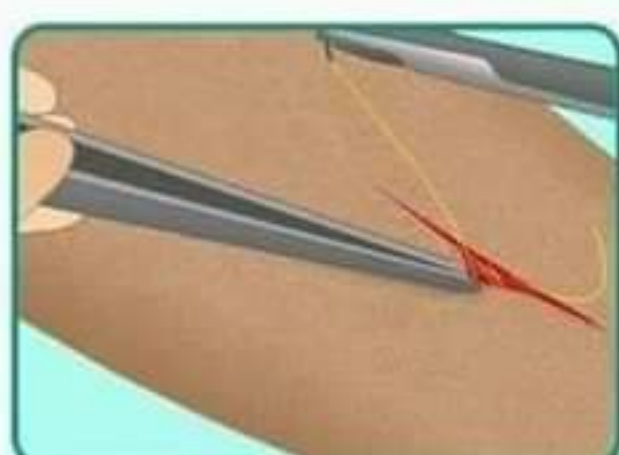
STEP 2



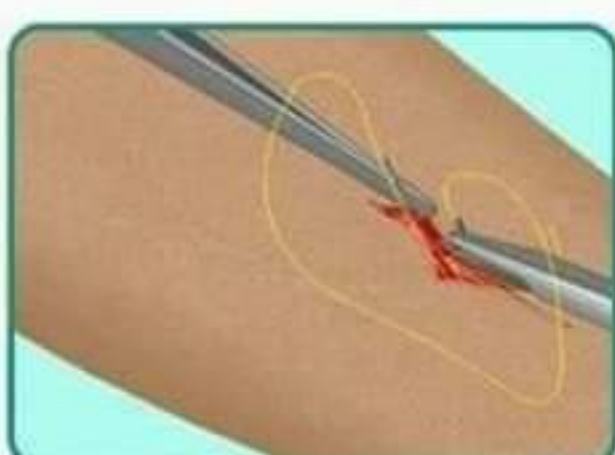
STEP 3



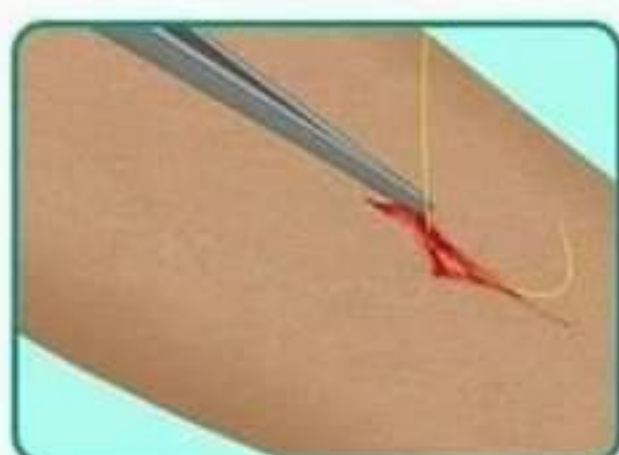
STEP 4



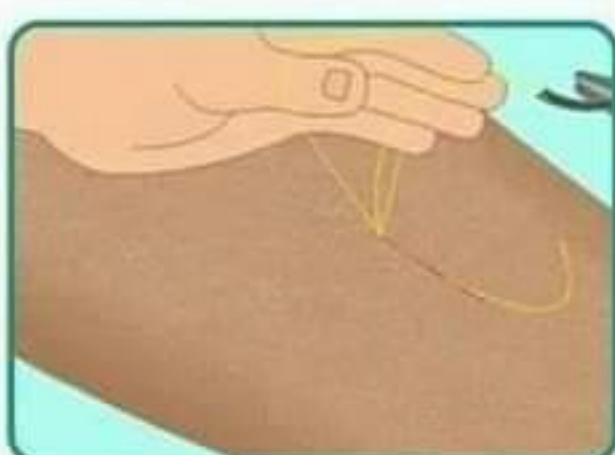
STEP 5



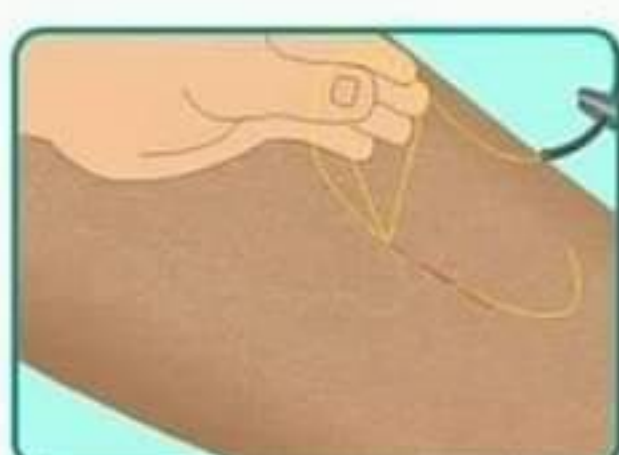
STEP 6



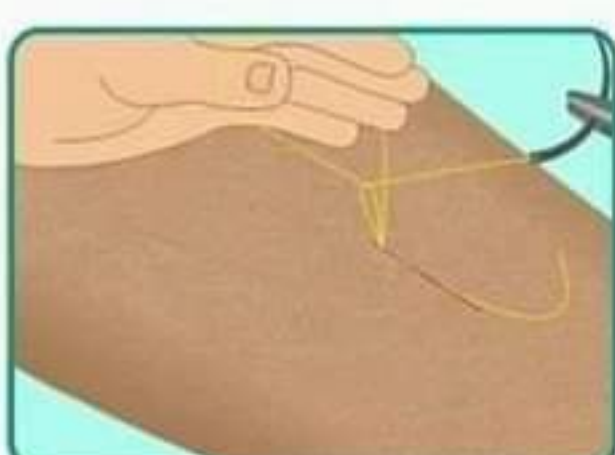
STEP 7



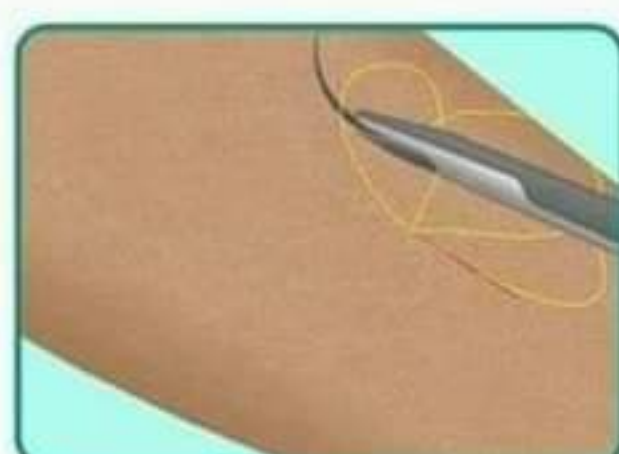
STEP 8



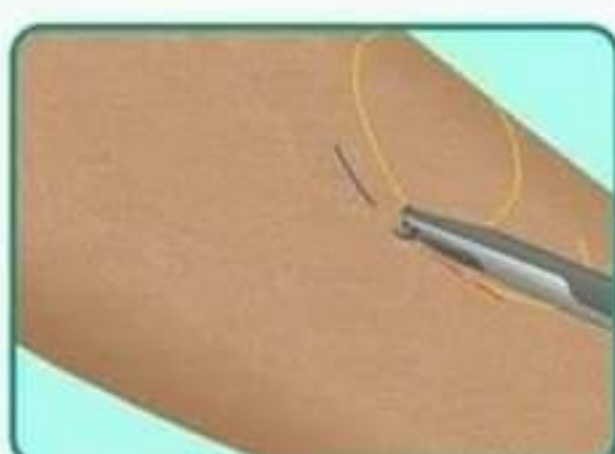
STEP 9



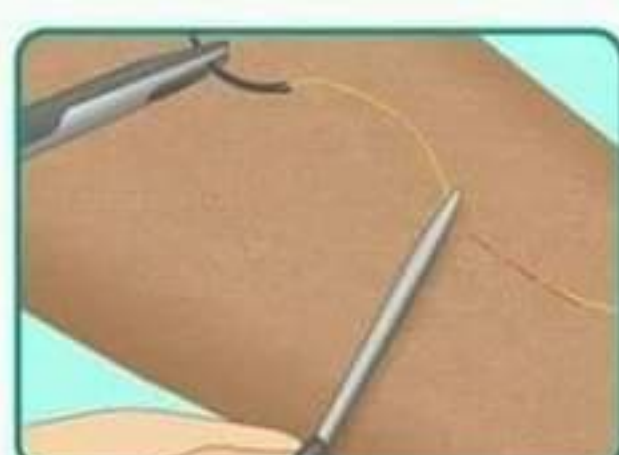
STEP 10



STEP 11



STEP 12



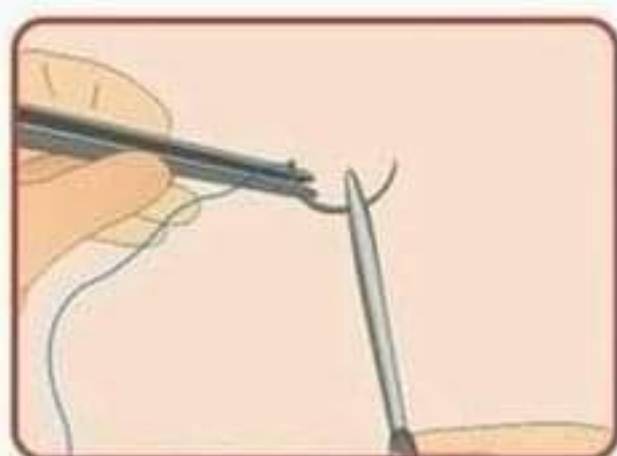
STEP 13



STEP 14

SUTURING TECHNIQUES

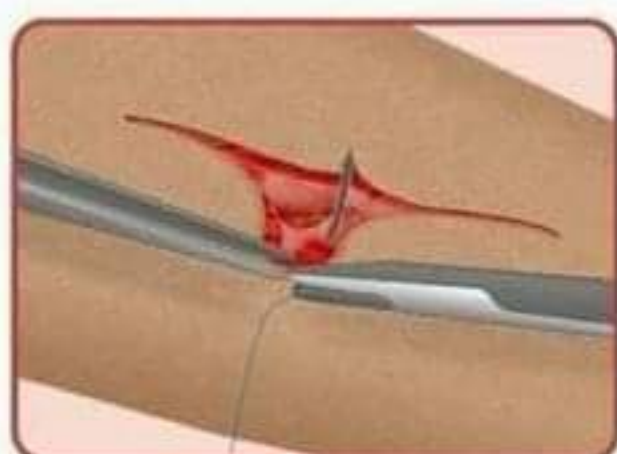
10. Figure - 8 - Suture



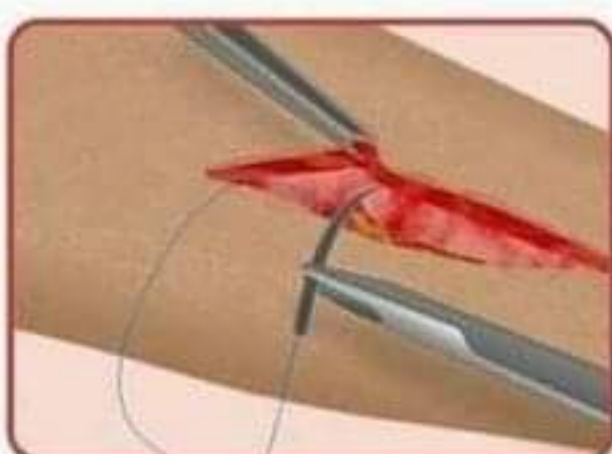
STEP 1



STEP 2



STEP 3



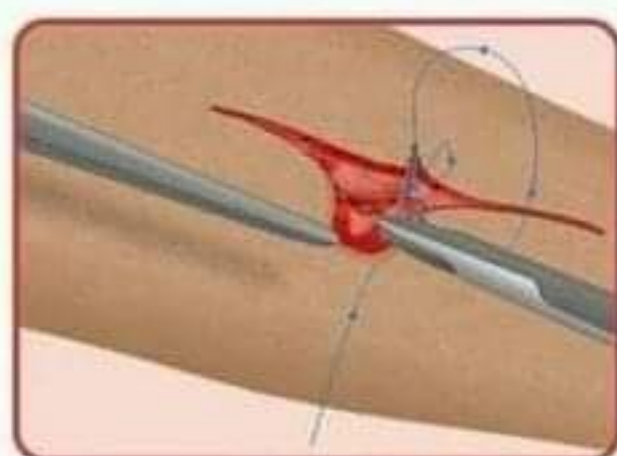
STEP 4



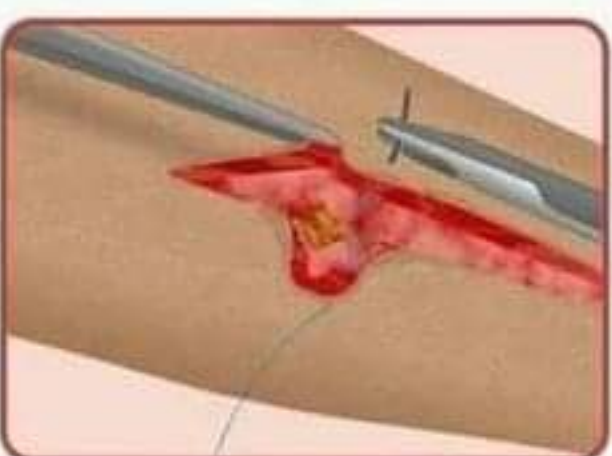
STEP 5



STEP 6



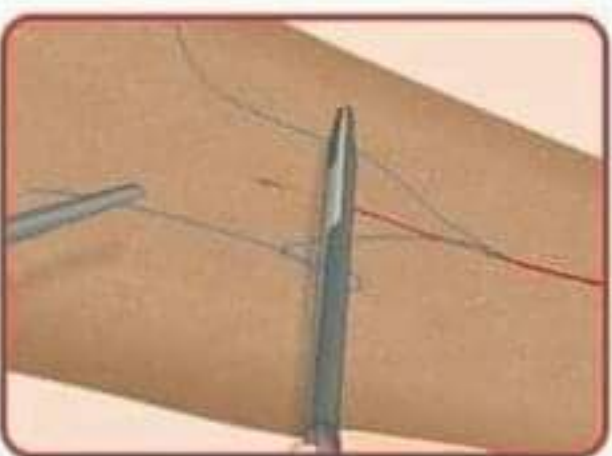
STEP 7



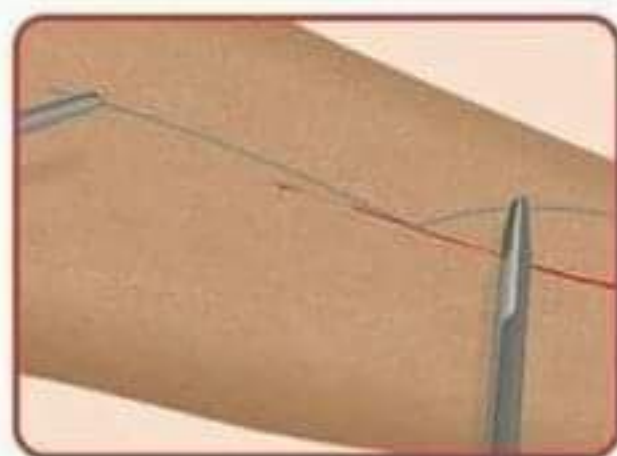
STEP 8



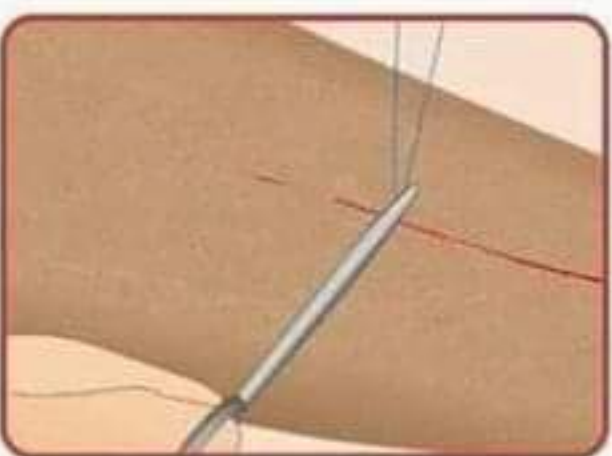
STEP 9



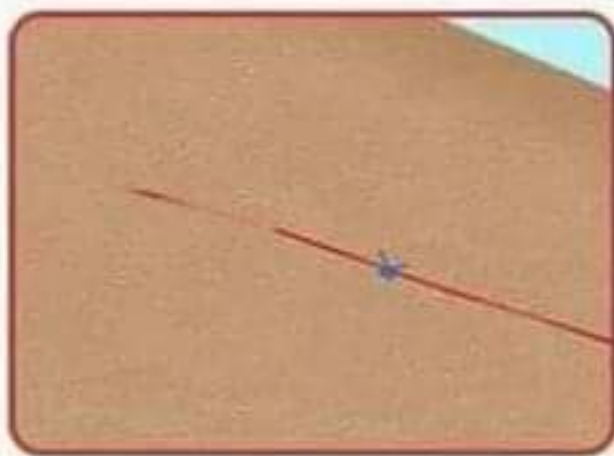
STEP 10



STEP 11



STEP 12



STEP 13