

# Basic Suturing

**Brief Overview:** This module is design to teach medical students and other novice surgical trainees about suture needles and materials, as well as basic suturing skills. Specifically, this curriculum demonstrates five commonly used suturing techniques: (1) simple interrupted, (2) horizontal mattress, (3) vertical mattress, (4) subcuticular interrupted, and (5) subcuticular running. In addition to step-by-step instructions complete with images, this proficiency-based curriculum incorporates technical skills assessment tools.

## I. Objectives

Upon completion of this skills training module, the learner will be able to:

1. Describe the differences between these suture materials:
  - a. Monofilament
  - b. Braided
  - c. Absorbable
  - d. Nonabsorbable
2. Describe the procedural aspects of the following suturing techniques:
  - a. Simple interrupted
  - b. Horizontal mattress
  - c. Vertical mattress
  - d. Subcuticular interrupted
  - e. Subcuticular running
3. Demonstrate the appropriate use of suture instruments (needle holder, scissors, and forceps)
4. Demonstrate proficiency for each suturing technique:
  - a. Inanimate model
  - b. Porcine/cadaver tissue model

## II. Assumptions

The learner will understand the basic principles of universal precautions, sterile technique, gentle tissue handling with forceps, and knot tying.

## III. Suggested Readings

1. Giddings RD. *Surgical Knots and Suturing Techniques*. 4<sup>th</sup> ed. Fort Collins, CO: Giddings Studio Publishing; 2013.
2. Kantor, J. *Atlas of Suturing Techniques: Approaches to Surgical Wound, Laceration, and Cosmetic Repair*. 1<sup>st</sup> ed. Columbus, OH: McGraw-Hill Education; 2016.
3. Danks RR. *Wound Closure Technique*. Available at: <https://emedicine.medscape.com/article/1836438-overview#a1>. Accessed January 17, 2018.

#### IV. Description of the Laboratory Module

Prior to the training module, educators will prepare individual suturing stations to include table-top barrier, inanimate/porcine model (fig. 1), needle driver, Adson forceps, suture scissors, and appropriate sutures. (Directions for constructing an inanimate model are provided as a supplement to this module.) If porcine or cadaver models are being used, then correct disposal of the material upon completion of the module should be assured in accordance with hospital or institutional policy. Optimum suture material depends on the model employed and availability. For example, 1-0 or 2-0 braided suture may be ideal for an inanimate model secondary to the ease of suture handling and knot tying; alternatively, 2-0 or 3-0 monofilament may be best for a porcine model to facilitate suture passage through porcine skin. Suture length of at least 18 cm is best. Taper needles work well for inanimate objects, while cutting needles facilitate suturing on a porcine model.

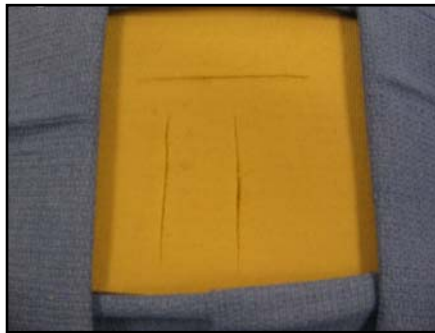


fig. 1

After learners are oriented to the specific equipment (name, function, and handling) and suture materials (monofilament, braided, permanent, and absorbable) to be used, they will observe the performance of each task by an expert. The demonstration of each suturing technique may be performed by an expert present during the training module. Alternatively, participants will view video demonstrations of each suturing task performed by an expert. Excellent suturing technique videos are freely available online or may be purchased from various sources.

Individualized attention is beneficial to ensure complete understanding and correct performance of each basic suturing technique, thus one proctor for every two to three trainees is optimal. Training begins with simple interrupted suturing to allow the learner a chance to practice instrument and tissue handling, then progresses to vertical and horizontal mattress suturing as modifications of simple suturing. Finally, trainees perform subcuticular suturing (interrupted and running) until levels of proficiency are reached for each task. A learner is considered proficient when expert-derived performance scores are met on two of three consecutive repetitions of the task during proctored testing.

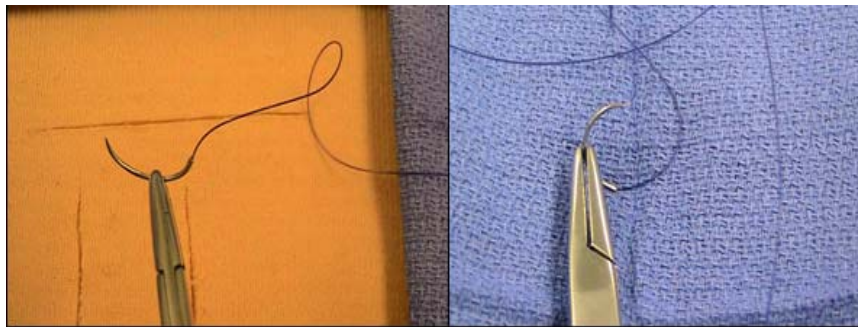
#### V. Description of Techniques and Procedure

A variety of techniques are available to close incised skin edges. Each technique is designed to accomplish the same goals: to decrease tension at the epidermal edge during healing, to precisely oppose the skin edges, to produce the least amount of trauma to the surrounding soft tissues, and to prevent wound infection by direct contamination. The following descriptions detail needle orientation and five suturing techniques. Models (inanimate and/or porcine) should have incisions of a similar length.

### **Task 1: Technique for Needle Orientation**

Steps as follows:

1. Grasp the suture needle one-third the distance from the swage between the tips of the needle driver. Hold the needle perpendicular to the long axis of the needle holder (fig. 2).
2. Refrain from handling the needle with fingers; instead, use the forceps to avoid injury.
3. Refrain from grasping the needle tip with the holder or the forceps to avoid dulling the needle.

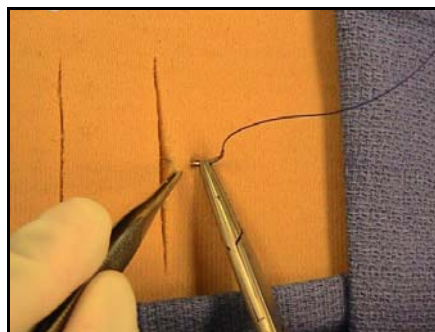


**fig. 2**

### **Task 2: Technique for Simple Interrupted Suturing**

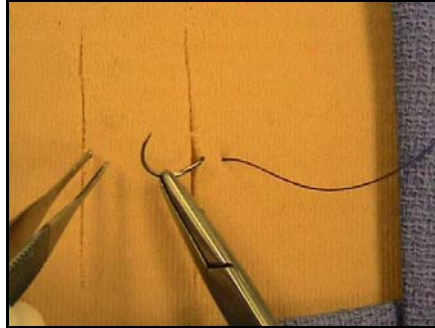
Steps as follows:

1. Using Adson forceps for skin retraction, insert the needle tip into the tissue approximately 0.5 cm to 1 cm from the wound edge (fig. 3), making sure to begin with the needle perpendicular to the tissue surface.



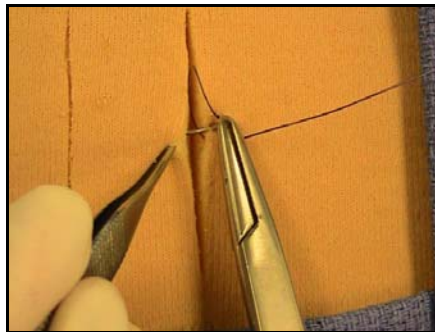
**fig. 3**

- Supinate the wrist clockwise 90 degrees to facilitate needle passage through tissue. The needle should traverse the epidermis, dermis, and a small portion of subcutaneous tissue if a porcine model is used (fig. 4).



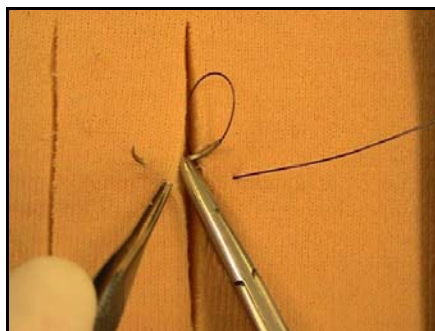
**fig. 4**

- Grasp the needle within the wound (avoid grabbing the tip, as doing so will dull the needle). Secure the needle with the forceps, regrasp it with the needle holder, and rotate the wrist clockwise 90 degrees to complete needle passage through tissue (fig. 5).



**fig. 5**

- Using Adson forceps for skin retraction, insert the needle tip into the subcutaneous tissue of the opposite wound edge. Supinate the wrist clockwise 90 degrees such that the needle exits the skin 0.5 cm to 1 cm from the wound edge (fig. 6). Secure the needle with the forceps, regrasp it with the needle holder with palms facing down and a supinate wrist, rotating the needle through the skin.



**fig. 6**

- Secure (tie) the knot using a two-handed technique (prerequisite) after removing the needle from the suture to approximate wound edges without undue tension (fig. 7). Alternatively, a one-handed or instrument tying technique may be used.

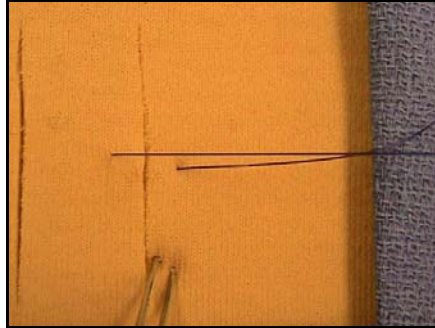


fig. 7

- Cut the suture, leaving a 1-cm tail on the suture.
- Space simple, interrupted sutures approximately 1 cm apart.
- This task should be repeated to a predetermined proficiency level.

### Task 3: Technique for Horizontal Mattress Suturing

Steps as follows:

- Begin with a simple, interrupted suture as described above.
- Load the needle in the back-handed position. Advance 0.5 cm to 1 cm along the long (horizontal) axis of the wound on the same side and reinsert the needle tip into the tissue approximately 0.5 cm to 1 cm from the wound edge, making sure to begin with the needle perpendicular to the tissue surface (fig. 8).

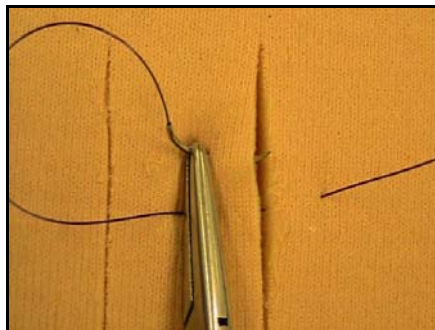
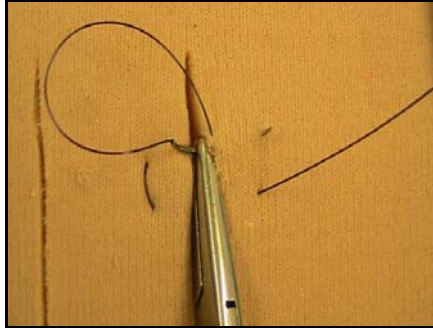


fig. 8

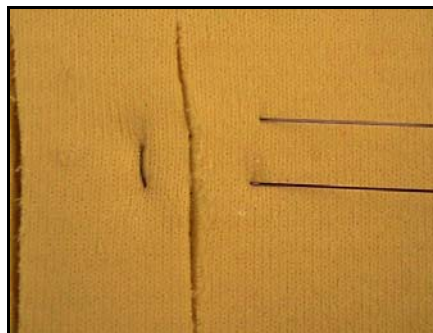
- Pronate the wrist counterclockwise 90 degrees to facilitate needle passage through tissue.
- The needle should traverse the epidermis, dermis, and a small portion of subcutaneous tissue if a porcine model is used.

5. Grasp the needle within the wound (avoid grabbing the tip, as doing so will dull the needle). Secure the needle with the forceps, regrasp with the needle holder, and rotate the wrist clockwise 90 degrees to complete needle passage through tissue (fig. 9).



**fig. 9**

6. Secure (tie) the knot using a two-handed technique (prerequisite) after removing the needle (fig. 10) from the suture to approximate the wound edges without undue tension. Alternatively, a one-handed or instrument tying technique may be used.



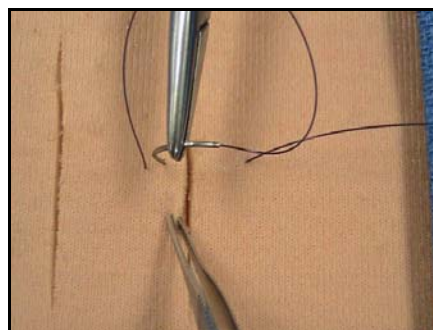
**fig. 10**

7. Cut the suture, leaving a 1-cm tail on the suture.
8. Space horizontal mattress sutures approximately 1 cm apart.
9. The task should be repeated to a predetermined proficiency level.

#### **Task 4: Technique for Vertical Mattress Suturing**

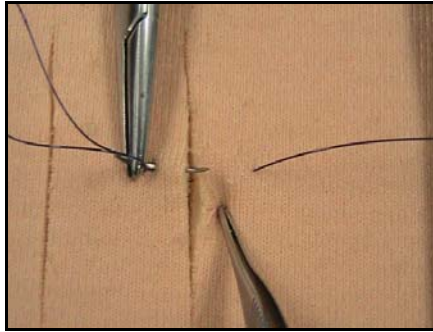
Steps as follows:

1. Begin with a simple, interrupted suture (fig. 11) as described above in Tasks 1–3.



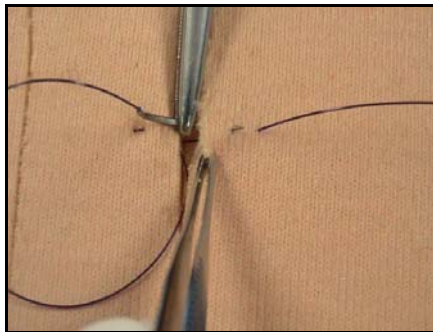
**fig. 11**

2. Reinsert the needle tip on the same side (fig. 12) approximately 0.1 cm to 0.2 cm from the wound edge at the intradermal level.



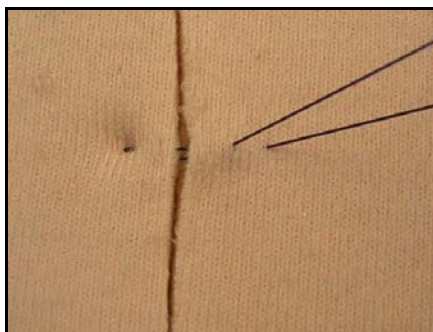
**fig. 12**

3. Pronate the wrist counterclockwise 90 degrees to facilitate needle passage through tissue.
4. Grasp the needle (fig. 13) within the wound (avoid grabbing the tip, as doing so will dull the needle) and pronate the wrist counterclockwise 90 degrees to complete needle passage through tissue. The needle should come out of the skin on the opposite side approximately 0.1 cm to 0.2 cm from the wound edge.



**fig. 13**

5. Secure (tie) the knot using a two-handed technique (prerequisite) after removing the needle from the suture (fig. 14) to approximate the wound edges without undue tension. Alternatively, a one-handed or instrument tying technique may be used. Cut the suture, leaving a 1-cm tail on the suture.



**fig. 14**

6. Space vertical mattress sutures approximately 1 cm apart.
7. The task should be repeated to a predetermined proficiency level.

## Task 5: Technique for Subcuticular Interrupted Suturing

Steps as follows:

1. Insert the needle tip into the tissue perpendicular to the wound edge (fig. 15). Start at the wound edge away from you. Enter tissue dermal-subcutaneous junction.

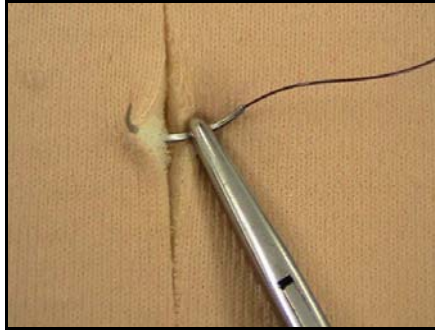


fig. 15

2. Supinate the wrist 90 degrees clockwise to facilitate needle passage through the tissue.
3. The needle tip should come out at the dermal-epidermal junction without including the epidermis (avoids puckering of the skin).
4. Reinsert the needle tip into the dermis on the opposite side of the wound (fig. 16) at the dermal-epidermal junction, with forearm and palm in pronated position.

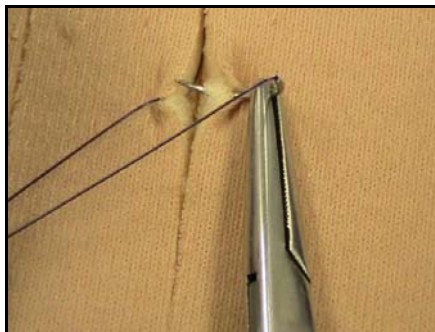


fig. 16

5. Supinate the wrist 90 degrees clockwise to facilitate needle passage through the tissue. The needle should exit at the dermal-subcutaneous tissue junction. Secure needle with forceps, regrasp with the needle holder, and supinate to facilitate needle passage through the tissue.
6. Secure (tie) the knot using a two-handed technique (prerequisite) after removing the needle from the suture to approximate the wound edges without undue tension. Alternatively, a one-handed or instrument tying technique may be used. Cut the suture on the knot.
7. Space sutures approximately 1 cm apart.
8. The task should be repeated to a predetermined proficiency level.



## Task 6: Technique for Subcuticular Running Suturing

Steps as follows:

1. Pass the needle tip through the subcuticular tissue at the apex of the wound furthest away from you. Secure (tie) the knot using a two-handed technique (prerequisite) (fig. 17). Cut the short end of the suture on the knot, leaving the needle in place.

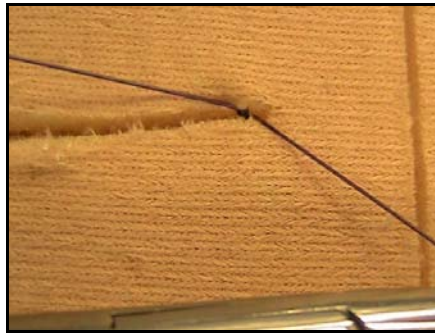


fig. 17

2. Insert the needle tip into the dermis parallel to the epidermis at the apex of the wound. Rotate the wrist to allow passage of the needle through tissue.
3. The needle tip should come out (fig. 18) of the dermis (at the dermal-epidermal junction) without including the epidermis (avoids puckering of the skin).

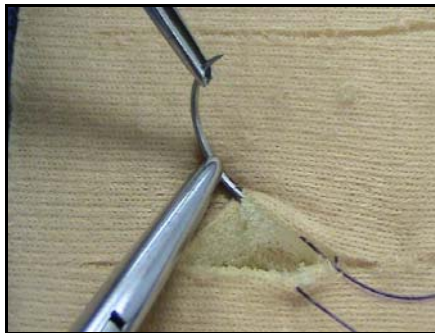


fig. 18

4. Reinsert the needle tip into the dermis parallel to the epidermis on the opposite side of the wound (fig. 19). Entry site should be directly opposite the last exit of the prior suture on the opposite side. Rotate the wrist to allow passage of the needle through tissue.

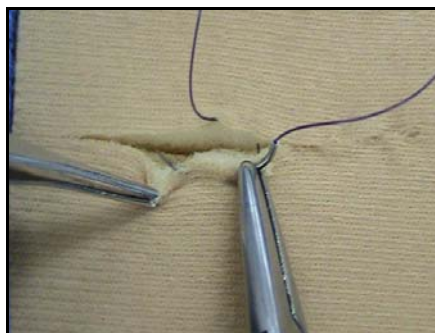
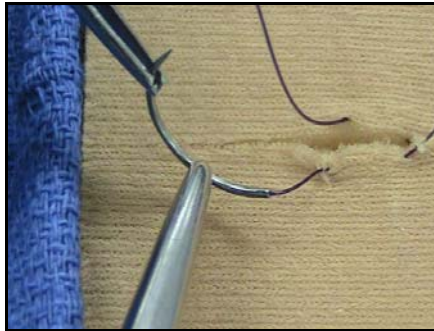


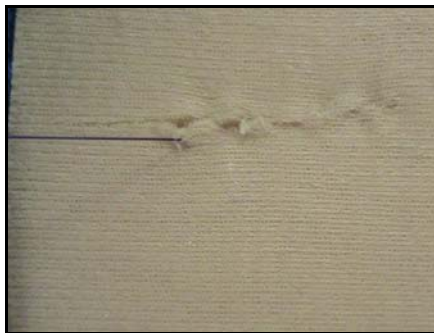
fig. 19

5. Instead of grasping the needle perpendicular to the needle holder, angle the needle approximately 45 degrees to facilitate passage of the needle through the dermis parallel to the epidermis (fig. 20).



**fig. 20**

6. Run the subcuticular stitch as close to the epidermal layer as possible to maximize wound edge eversion.
7. Continue sewing toward you until entire incision is reapproximated (fig. 21).



**fig. 21**

8. Secure (tie) the knot using a two-handed technique (prerequisite) after removing the needle from the suture to approximate the wound edges without undue tension. Alternatively, a one-handed or instrument tying technique may be used. Cut the suture on the knot then bury the knot with a simple interrupted suture beyond the edge of the wound.
9. The task should be repeated to a predetermined proficiency level.

## **VI. Common Errors**

1. Grasping the needle tip with forceps or needle holder can result in:
  - a. Blunting of the needle tip
  - b. Increased tissue trauma during needle passage
  - c. Increased wound complication rate
2. Inappropriate tension during wound closure:
  - a. Too little tension on the wound closure can result in poor cosmesis and increased risk of infection.
  - b. Too much tension on the wound closure can lead to poor cosmesis and skin necrosis.

- c. The best methods to avoid these errors are to practice gentle tissue handling and to ensure appropriate tension on the wound edge during knot tying.
3. Failure to evert the wound edges, particularly with simple, interrupted suturing:
    - a. Results in poor cosmesis and may increase wound infection rate
    - b. Can be avoided by inserting the needle tip perpendicular to the skin then angling the needle toward the center of the wound as the needle tip passes through the subcutaneous tissue

## VII. Expert Performance Video

An expert performance video for each technique described in this module is available at <http://MedStudentSimSkills.facs.org> under Year 3 Module 3.

## VIII. Supplies and Station Set-Up

Regardless of the model employed (inanimate or porcine), each participant should have one model and one of each of the supplies listed below. Directions for constructing an inanimate model are provided as a supplement to this module. In addition, appropriate sharps and biomaterial disposal should occur immediately following the educational module.

- Chuck and/or surgical towel to protect the tabletop
- Personal protective equipment (eye wear, gown, gloves, and mask)
- Inanimate model or fresh pig's foot
- Scalpel handle and 10 blade, or a disposable scalpel
- Standard needle holder
- Suture scissors
- Adson forceps
- 2-0 and 3-0 silk, nylon, and/or polypropylene sutures (multiple)

## IX. Suggested Module Length

One hour and 30 minutes total

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