

# Basic Knot Tying

**Brief Overview:** In this module, the student will be taught and evaluated on basic knot tying. Using a knot tying board and bi-colored rope, the student is to demonstrate the proper technique for a two-handed knot. The target performance is defined as the correct placement of a square knot that is tight and flat with equal horizontal tension. This skills-based module should be considered a requirement of every third-year student.

## I. Objectives

At the end of this session, the students will be able to:

1. Understand the basic principles of knot tying.
2. Demonstrate a two-handed knot.
3. Demonstrate an instrument tie.

## II. Assumptions

The student will have reviewed the two skills in one of the following suggested resources.

NOTE: Ethicon Knot Tying Kits are currently unavailable with no recovery date. Please visit our website for updates on availability at <https://www.ethicon.com/na/education-support/customer-support> . Once the product is available you will find a link in the Frequently Asked Questions section that will pull up a web form for order processing. If you are unable to find a link the product is still unavailable.

## III. Suggested Resources

1. LaMorte WW. Basic knot tying and suturing. Available at: <http://www.bumc.bu.edu/surgery/training/technical-training/basic-knots-sutures/>. Accessed March 7, 2013.
2. Covidien *Surgical Knot Tying Manual*. Third edition. Available at: <http://www.covidien.com/imageServer.aspx?contentID=11850&contenttype=application/pdf>. Accessed March 7, 2013.
3. Sherris DA, Kern EB. *Basic Surgical Skills*. Rochester, MN: Mayo Foundation for Medical Education and Research; 1999.

## IV. Description of the Laboratory Module

The students are initially placed in a conference room with a computer and large wall-mounted digital display. The computer monitors continuously loop the muted instructional skills video for the skill being performed during that session. The faculty organizer reviews the objectives and equipment, introduces faculty and resident

proctors, provides an overview of the timeline, and reviews the skills videos with the students as a group.

The students then break out into groups of five to six per faculty or resident instructor and are organized around an adjustable-height table. An operating room (OR) table (five to six students), stretcher (five to six students), or bedside table (three students) works well. A few extra knot tying boards should be kept in the simulation lab for these sessions.

The proctor for each table demonstrates the complete skill and then makes sure everyone sets up their knot tying boards and bi-colored ropes in the same orientation for ease of group instruction. It is helpful to identify left-handed students and group them together. The first throw is reviewed by the instructor with the group. The instructor then goes individually to each student to help the student master this step. This process is repeated for the second throw. The instructor then individually assesses each student's technique and provides feedback until the student has mastered the two-handed knot using the rope. It is then helpful to practice with braided suture.

The instrument tie is taught in the same manner as the two-handed knot but is incorporated into the skill session for the simple interrupted suture, which is performed using an inanimate model, one side of the rubber tubing on the knot tying board, or a pig's foot. (Instructions for constructing an inanimate model are included with this module.) The instrument tie can also be taught using the rope and knot tying board as demonstrated in the Expert Performance Video section of this module.

## V. Description of Techniques and Procedure

### Task 1: Two-Handed Knot, Right-Handed Surgeon

1. Place the knot tying rope under the rubber tubes on the knot tying board. Be sure the white side of the rope, which represents the side of the suture with the needle attached, faces away from the surgeon. Lay it across the left hand as shown below (fig. 1).



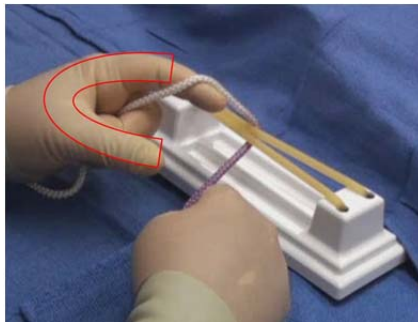
**fig. 1**

2. Grasp the white side of the rope with the third, fourth, and fifth fingers of the left hand, applying adequate tension to pull the rope taut (fig. 2).



**fig. 2**

3. Bring the white side of the rope over the index finger and create a “c” between the index finger and the thumb on the left hand (fig. 3).

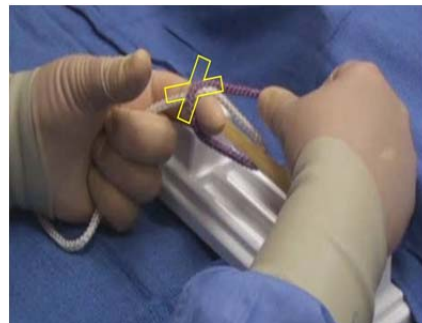


**fig. 3**

4. Bring the purple side of the rope up to the index finger from the opposite side of the white side (fig. 4). This will create and close a loop below the fingers and create an “X” on the index finger (fig. 5).



**fig. 4**



**fig. 5**

5. Pinch the thumb to the index finger (fig. 6).



**fig. 6**

6. Push the thumb and index finger through the loop (fig. 7).



**fig. 7**

7. Lift the index finger and lay the purple “tail” on the thumb of the left hand (fig. 8).



**fig. 8**

8. Pinch the purple “tail” between the index finger and the thumb (fig. 9).



**fig. 9**

9. Push the index finger and the thumb back through the loop (fig. 10).



**fig. 10**

10. Pull the purple “tail” through the loop with the right hand (fig. 11).



**fig. 11**

11. Pull the purple end away from the surgeon, applying equal horizontal tension until the first “throw” of the square knot is down flat and tight (fig 12).



**fig. 12**

12. Pronate the left hand so that the thumb comes under the white end, recreating the “c” between the index finger and the thumb (fig. 13).



**fig. 13**

13. Bring the purple end to the thumb from the side opposite of the white end, closing the loop and making an “X” on the thumb (fig. 14).



**fig. 14**

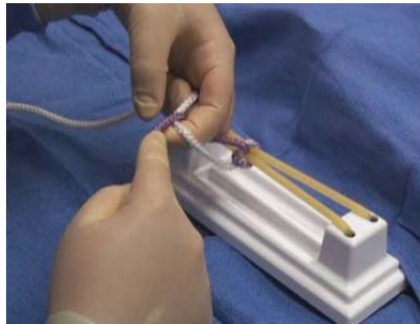
14. Pinch the index finger to the thumb (fig. 15).





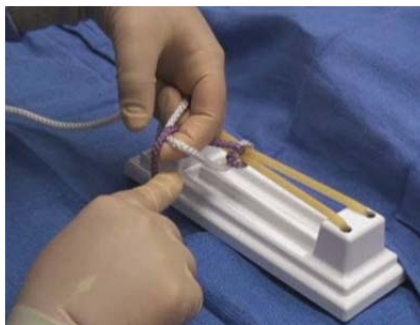
**fig. 15**

15. Push the index finger and thumb through the loop, lifting the thumb off the index finger once it's through the loop (fig. 16).



**fig.16**

16. Place the purple "tail" on the index finger (fig. 17).



**fig. 17**

17. Pinch the purple "tail" between the thumb and the index finger (fig. 18).



**fig. 18**

18. Push the thumb and the index finger through the loop (fig. 19).



**fig. 19**

19. Pull the purple “tail” through the loop and pull it down toward the surgeon. Apply equal horizontal tension until the second throw of the knot is down tight and flat. One throw of the square knot is now complete (fig. 20).

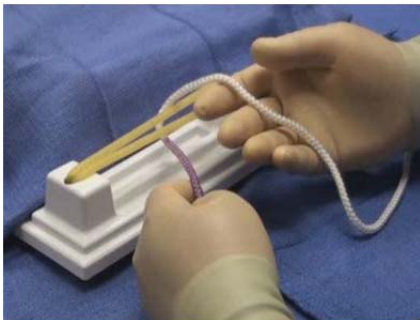


**fig. 20**

20. Repeat steps 1 to 19 accordingly, depending on how many knots are desired. The number of knots will vary with braided and monofilament sutures.

### **Task 2: Two-Handed Knot, Left-Handed Surgeon**

1. Place the knot tying rope under the rubber tubes on the knot tying board. Be sure the white side of the rope, which represents the side of the suture with the needle attached, faces away from the surgeon. Lay it across the right hand as shown below (fig. 21).



**fig. 21**

2. Grasp the white side of the rope with the third, fourth, and fifth fingers of the right hand, while applying adequate tension to pull the rope taut (fig. 22).

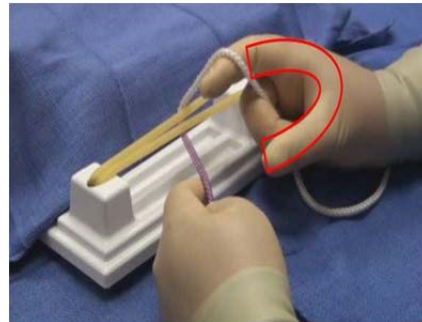


**fig.22**

3. Bring the white side of the rope over the index finger (fig. 23) and create a reverse “c” between the index finger and the thumb on the right hand (fig. 24).



**fig. 23**

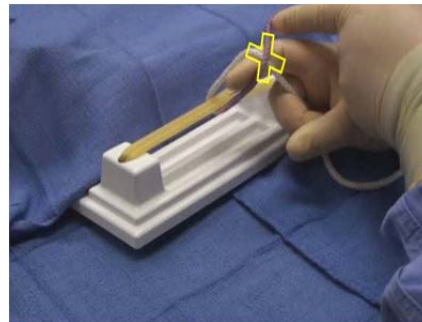


**fig. 24**

4. Bring the purple side of the rope up to the index finger from the opposite side of the white rope (fig. 25). This will create and close a loop below the fingers and create an “X” on the index finger (fig. 26).



**fig. 25**



**fig. 26**

5. Pinch the thumb to the index finger (fig. 27).



**fig. 27**

6. Push the thumb and the index finger through the loop (fig. 28).





**fig. 28**

7. Lift the index finger and lay the purple “tail” on the thumb (fig. 29).



**fig. 29**

8. Pinch the purple “tail” between the index finger and the thumb (fig. 30).



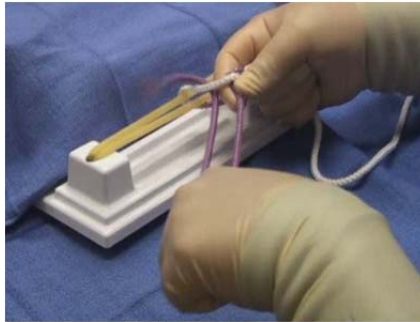
**fig. 30**

9. Push the index finger and the thumb back through the loop (fig. 31).



**fig. 31**

10. Pull the purple “tail” through the loop with the left hand (fig. 32).



**fig. 32**

11. Pull the purple “tail” away from the surgeon, applying equal horizontal tension until the first “throw” of the square knot is down flat and tight (fig. 33).



**fig. 33**

12. Place the thumb under the white end, recreating the reverse “c” between the index finger and thumb (fig. 34).



**fig. 34**

13. Bring the purple end to the thumb from the side opposite of the white end, closing the loop and making an “X” on the thumb (fig. 35).



**fig. 35**

14. Pinch the index finger to the thumb (fig. 36).



**fig. 36**

15. Push the index finger and the thumb through the loop, lifting the thumb off the index finger once it goes through the loop (fig. 37).



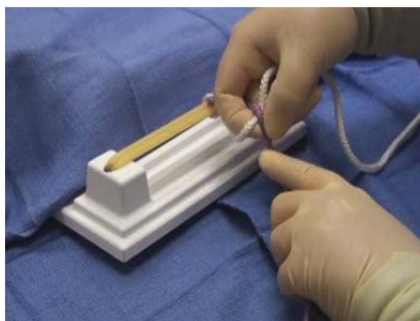
**fig. 37**

16. Place the purple “tail” on the index finger (fig. 38).



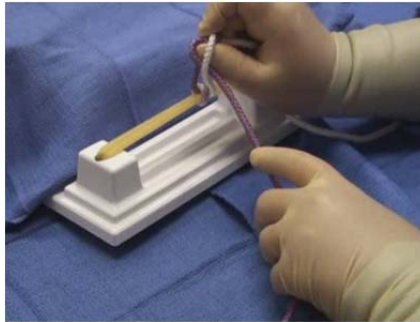
**fig. 38**

17. Pinch the purple “tail” between the thumb and the index finger (fig. 39).



**fig. 39**

18. Push the thumb and the index finger through the loop (fig. 40).



**fig. 40**

19. Pull the purple “tail” through the loop with the left hand (fig. 41) and pull down toward the surgeon, applying equal horizontal tension until the second throw of the knot is down tight and flat (fig. 42). One throw of the square knot is now complete.



**fig. 41**

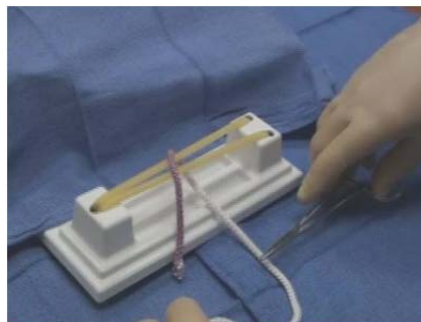


**fig.42**

20. Repeat steps 1 to 19 accordingly, depending on how many knots are desired. The number of knots will vary with braided and monofilament sutures.

### **Task 3: Instrument Tie, Right-Handed Surgeon**

1. Place the knot tying rope under the rubber tubes on the knot tying board (fig. 43). Be sure to place the white side of the rope, which represents the side of the suture with the needle attached, under the tubes and toward the surgeon. Be sure the short purple end, which represents the tail, rests over the tubes on the side away from the surgeon. Note that the purple tail is draped over the tubes so it is on the same side as the white end. It is not actually sewn to anything and thus this the only way to begin this task in this model so that the knot starts over the tail.



**fig. 43**

2. Grasp the white side of the rope with the left hand (fig. 44).



**fig. 44**

3. Place the needle driver between the purple and white strands of the rope (fig. 45).



**fig. 45**

4. Perform a “forward throw” by wrapping the white end of the rope over the needle driver toward the tail (fig. 46).



**fig. 46**

5. Pull the purple tail through the loop (fig. 47).



**fig. 47**

6. Pull the tail toward the surgeon, which is 180 degrees from the tail’s original side. Note that the tail started on the side of the tubes away from the surgeon (fig. 48).





**fig. 48**

7. Stand the tail's end up (fig. 49) so it is easier to grasp after the next throw.



**fig. 49**

8. Place the needle driver between the two ends of the rope again (fig. 50) and perform another "forward throw" toward the purple tail (fig. 51).



**fig. 50**



**fig. 51**

9. Grasp the purple tail (fig. 52).



**fig. 52**

10. Pull it through the loop (fig. 53) and down (fig. 54), opposite from its starting point. This is away from the surgeon for the second throw.

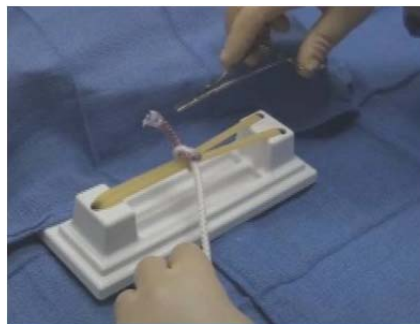


**fig. 53**



**fig. 54**

11. One square knot has now been completed. Leave the tail up so it is easier to grasp for the next throw (fig. 55). A variable number of throws will be completed depending on whether a braided (three to four throws) or a monofilament suture (four to six throws) is used.



**fig. 55**

## **VI. Common Errors**

- Hands are located an inappropriate distance from the knot. Many novices will hold the suture too far from the knot.
- Not enough tension is applied.
- The hands go through too large a range of motion while pulling the sutures down.
- The suture is held too far from the knot resulting in an inadequate length available to grasp the suture in the nondominant hand. To correct this problem, the student is asked to place the junction of the two colors of the tying rope under the rubber tubes on the knot tying board and move the hands about halfway up each side of the rope to begin the exercise.
- The suture is held too close to the knot. This results in poor efficiency, as now the tail is long and cumbersome to pull through the loop.
- The fourth and fifth fingers are used to “hook” the tail and pull it through the loop instead of maintaining adequate tension and pinching and pushing the suture through the loop to maintain control.
- Inadequate or unequal tension is applied to the throw as it is pulled down., which results in “air knots.”

## **VII. Expert Performance Videos**

Expert performance videos demonstrating the skills listed below are available at WEBSITEHOME under Year 3 Module 2.

- Two-handed knot tying, right handed surgeon
- Two-handed knot tying, left handed surgeon
- Two-handed knot tying, expert
- Instrument tie
- Instrument tie, expert

## **VIII. Supplies and Station Set-Up**

Required equipment:

- Knot tying board
- Knot tying rope (bi-colored preferable)
- Needle driver
- Forceps
- Suture scissors
- Braided 2-0 sutures and ties
- Monofilament 3-0 sutures and ties
- Pigs' feet or inanimate suturing models
- Adjustable-height table—OR table, stretcher, or bedside table
- Sharps container
- Computer with large enough display to play video clips continuously for reference

The students have their own knot tying boards for further practice. They are instructed to change to suture for practice following this initial skills sessions. The students are encouraged to ask for unused or expired suture in the OR for additional practice. They can also purchase cotton thread from various fabric and sewing stores and cut lengths of thread to practice knot tying. Disposable suture sets are sometimes opened and not used; these are good sources of instruments. Many hospitals have old instruments that have been removed from OR sets and are available from surplus storage at no charge to the students. Inexpensive suture sets can also be ordered from the Internet. Additionally, instructions are provided with this module to assist students in constructing an inanimate suturing model that can be used for additional practice.

## **IX. Suggested Module Length**

One hour and 30 minutes total

- Forty-five minutes for two-handed knot
- Fifteen minutes for instrument tie alone
- Forty-five minutes for instrument tie taught with simple interrupted suture

**Author:**

***Celeste Hollands, MD, FACS***  
*Adjunct Associate Professor of Surgery*  
*University of South Alabama, Mobile, AL*  
*St. John's Children's Hospital, Springfield, IL*  
*The Children's Hospital at Albany Medical Center, Albany, NY*

**Assessment Consultant:**

***Maura Sullivan, MSN, PhD***  
*Associate Professor, Associate Chair for Education*  
*Executive Director, Surgical Skills and Simulation Center*  
*Department of Surgery*  
*Keck School of Medicine of University of Southern California, Los Angeles, CA*