Medical Creations

SUTURE *like a* SURGEON

A doctor's guide to surgical knots and suturing techniques used in the departments of surgery, emergency medicine, and family medicine.

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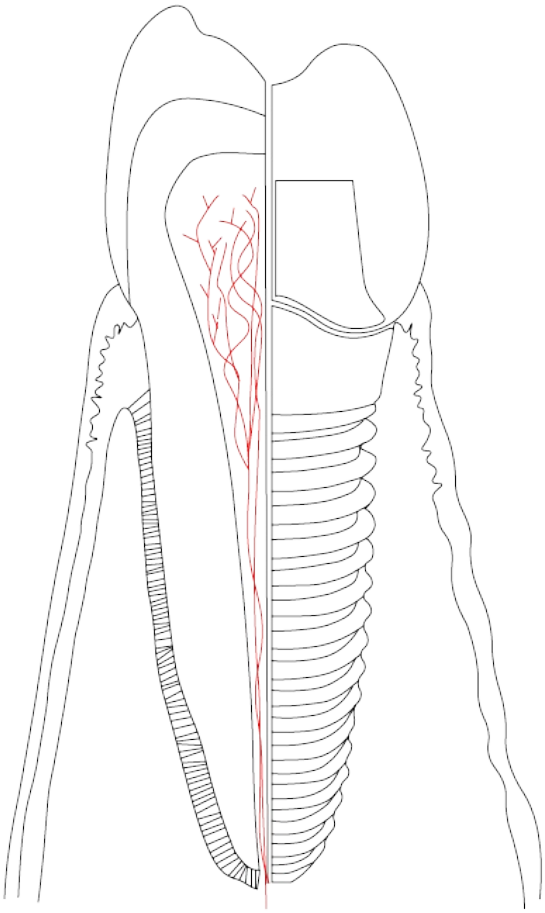

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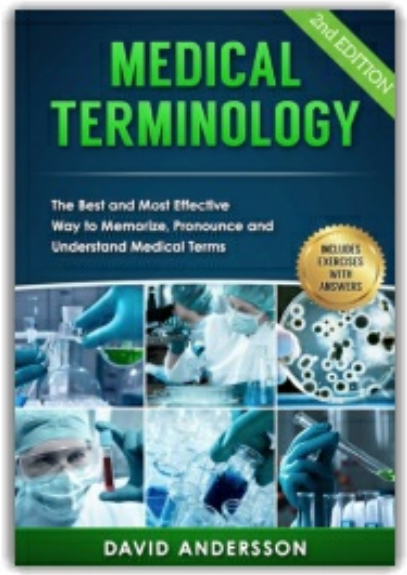

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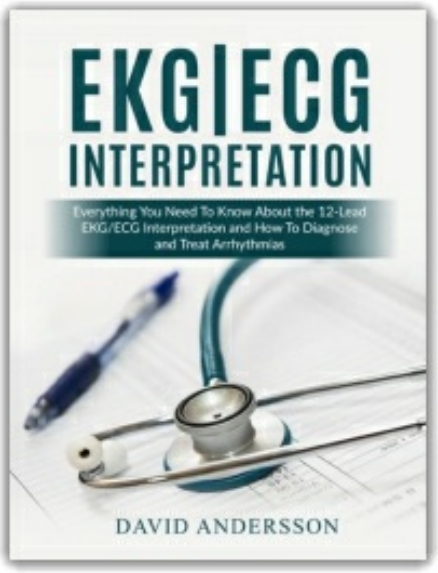

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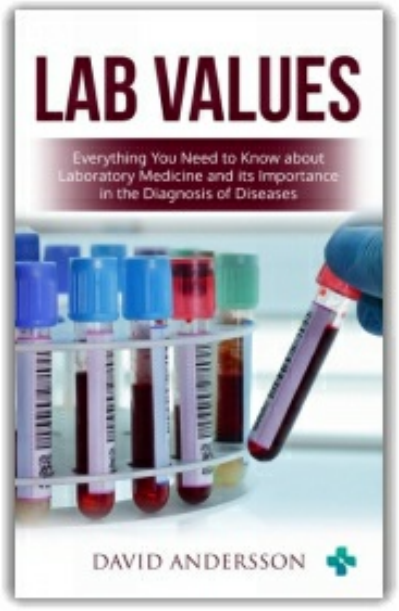

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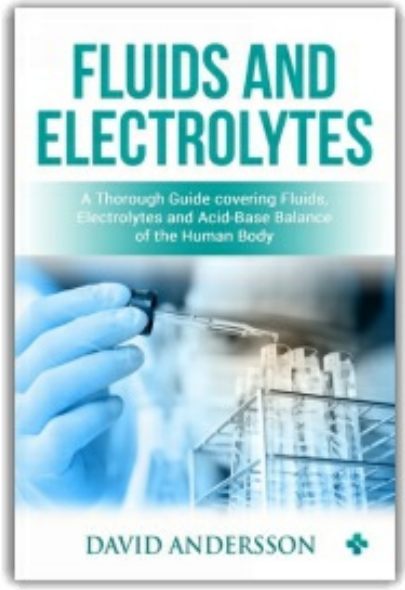

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INTRODUCTION

The word ‘suture’ refers to the use of a thread-like material to either approximate tissues together, or ligate (seal off) blood vessels. Suturing is a technique that has been practiced for centuries. The first reference to suturing goes back to 3000 BC, and can be found in ancient Egyptian literature. Several materials have been used over the years, including hemp, cotton, and silk. Similarly, needles have also been made of several different materials – bone, silver, bronze, and copper.

Over the years, both the materials used for suturing and techniques have undergone extensive amount of refinement. Suturing techniques today are under sterile, aseptic conditions, and with the use of well-crafted instruments. However, certain principles have remained same over the years, and these are essential for the success and maintenance of tissue integrity.

Most students (and even some residents) assume that the purpose of suturing is to hold incisions together. While this is true, suturing is also useful for a variety of other purposes. Some common applications of suturing techniques are given below:

- To close incisions, allowing primary healing.
- To approximate wound margins after raising a flap or biopsy, allowing secondary healing.
- To promote hemostasis by closing bleeding wound edges.
- To ligate blood vessels.
- To approximate ends of blood vessels (called anastomosis), allowing blood to be re-routed to different areas. One common example of this is the cardiac bypass surgery.
- To repair severed nerves and tendons.
- To temporarily anchor tissues and retract them during surgery, improving access and visibility.

The process of suturing, on the surface, appears to be a simple affair and is generally left to the junior most residents or surgical interns at the end of

surgery. However, suturing can also be the most critical stage of surgery. If suturing is not carried properly, a host of postoperative complications can result. These include wound breakdown, incisional hernia, improper healing and scarring, postoperative bleeding, and wound infection. Therefore, it is imperative that students train themselves with skills necessary to carry out the suturing process.

This suturing manual gives you an insight into basics of the suturing process. The first part of the manual will cover the armamentarium required, indications, and basic principles of suturing techniques. The next part will discuss knot tying, different kinds of sutures, and their applications. The last section will also discuss wound care before and after the suturing process.

CHAPTER 1
Armamentarium

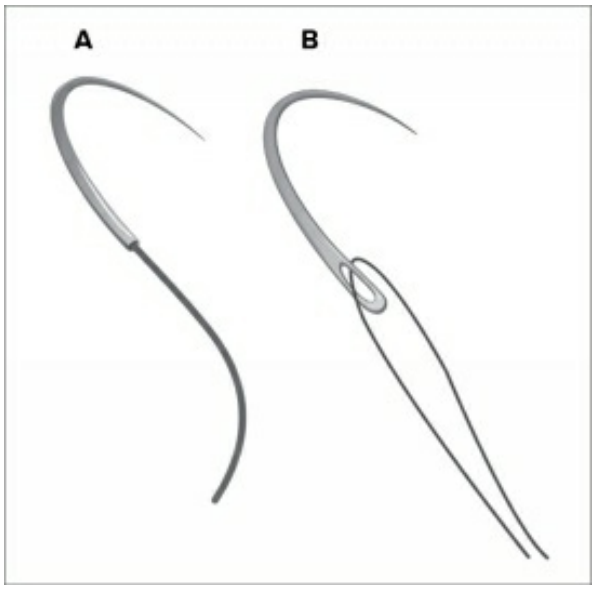
For successful suturing, two materials are required –surgical needle and suture material. These can be manipulated by a hand-held instrument, namely the needle holder. A few other instruments that come in handy are the tissue holding forceps that helps to stabilize the tissue being sutured, and a pair of scissors for cutting the sutures. Each of these is described in detail in the subsequent sections.

SUTURE NEEDLES

Surgical needles are basically used to carry the suture material into the tissue. They pierce the skin or deeper layers, and transfer the material mounted on them through the tissues. The ideal needle should possess the following properties:

- Be rigid enough to resist distortion.
- Be flexible enough to bend rather than break off.
- Be sharp enough to penetrate tissues easily.
- Be slim enough to cause minimum tissue trauma.
- Be capable of being held snugly in the needle holder without turning.
- Be capable of being sterilized easily.

Usually, needles are made of surgical grade stainless steel, as this fulfills most of the above properties. A needle has three components –eye, body, and tip.



Needle end: This is the portion that contains mounted suture material. The needle can have either an end with an ‘eye’, through which the suture material is threaded (b), or it can be eyeless. Eyeless needles are also called swaged needles, and the suture material is crimped within the needles (a). Swaged needles produce lesser tissue trauma than needles with eyes, as only one strand of the suture material is pulled through. Needles with eyes carry two strands of material, and possibly a knot through the tissue. This also creates a hole that is wider than the final suture material that remains behind, which can potentially cause leakage and infection. Swaged needles are meant only for single use, and therefore loss of needle sharpness and sterilization do not present a problem. Needles with eyes, however, may be more cost-effective.

In swaged needles, there are two ways of attaching the suture needle to the material – laser drilling, and channel fixation. Laser drilling involves boring a hole into the tail end of the needle, into which the suture is fixed. In channel fixation, a small cut or channel is placed at the needle end for half its thickness, and the material is affixed into this depression.

Needle body: This reflects the shape of the needle. The needle body may either be straight or curved. Curved needles come with different degrees of curvatures, including a half-circle, 1/4th circle, 3/4th circle, 3/8th circle, or 5/8th circle. While the 3/8th needle is most commonly used for suturing, the other kinds also have certain applications. These have been outlined in Table 1.

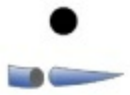
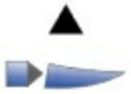
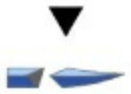
Table 1. Classification of needles based on body curvature

Type of Needle Body	Applications
Straight needle	Rarely used, when skin closure is done by hand.
Half curved (ski needle)	Laparoscopic surgery.
¼ circle	The shallow curvature makes it convenient for convex surfaces. Used in ophthalmic surgery and microsurgery.
3/8 circle	Most commonly used. Best for superficial and large wounds. It needs a wide arc of rotation, so is not suitable for deep wounds.
½ circle	It is used in confined spaces such as gastrointestinal tract, peritoneum, and respiratory tract.
5/8 circle	Used in deep, confined spaces, does not require much of lateral space for rotation. These include urogenital tract, pelvis, throat, and oral cavity.

Needle tip: It is the point that begins penetration into the tissue. Needle tips may be classified based on their cross-section. The cross-section shape is important as it reflects the ability of the needle to pass through tissues. A sharp cross-section penetrates tissues easily, and is useful for tougher structures. A smooth, round cross-section may be preferable for sift and friable tissues. The different kinds of needle tips and their applications have been outlined in Table 2.

Table 2. Classification of needles based on cross-section of the tip

Type of Needle Tip	Cross Section	Applications	Symbol
Round bodied – tapered	Circular, tapers to a point at tip	Muscle, fascia, mucosa, peritoneum,	

		abdominal viscera	
Blunt round bodied	Circular, rounded tip	Ocular muscle, parenchymatous tissue	
Cutting	Triangle, cutting edge on concave surface	Tough sclerotic tissue, sternum	
Reverse cutting	Reverse triangle, cutting edge on convex surface	Tissues that are tough but can tear, e.g. skin	
Spatula	Trapezoidal	Ophthalmic surgery, microsurgery	

SUTURE MATERIAL

The suture material is of great importance because it is actually going to hold the tissue together during healing phase. This material should therefore have structural integrity, and at the same time, must not cause damage to the tissue. There are several properties that an ideal suture material must possess. These include the following:

- It should be sterile or must be capable of being sterilized without affecting its structural integrity.
- It should be biocompatible, and should not cause tissue reaction or irritation.
- It should be easy to handle.
- It should not fray or break off easily, and allow proper knot security.
- It should have a high tensile strength, maintained during the healing phase.
- Once the healing phase is complete, it should have a suitable

absorption profile.
- It should have antibacterial properties.
- It should be cost-effective.

Unfortunately, the ideal suture material does not exist at present, and most commonly available materials lack one or more of the above characteristics. Therefore, the surgeon must choose the best possible material depending on the tissue to be sutured, anatomical location, and host factors.

Types of Suture Materials

Suture materials can be classified based on their source of origin as natural materials or synthetic materials. Natural suture materials have been largely replaced by synthetic materials now, as synthetic materials produce less amount of tissue reaction, and have more predictable properties such as tensile strength and rate of absorption. However, natural materials are more cost-effective, and are therefore still widely used in places where cost is a major consideration. Natural silk is often used for securing drains.

Based on behavior of the material in the body, suture materials can be further classified as absorbable and non-absorbable materials.

Absorbable Materials: Absorbable materials get digested by the body enzymes or by hydrolysis after a specific period of time. The rate of absorption is important for these materials, as the absorption process obviously weakens the structural integrity of the material. Ideally, absorption should start only when the wound has gained adequate tensile strength. Absorption rate can be influenced by the type of material, the area of the body where the suture is placed, and host factors. These sutures are useful when deeper layers of the body are sutured, as suture removal is not possible in these areas. These materials are also used in areas that heal rapidly, such as small bowel anastomosis, urinary tract, and biliary tract.

Non-absorbable Materials: Non-absorbable materials are preferred when long-term tissue support is needed. These materials either need to be removed manually, or get walled off by the body's inflammatory processes. These can be used for superficial wounds, wounds that need to heal slowly such as vascular ligation or anastomoses, and to suture muscle, tendons, fascia, and abdominal wall closure. Non-absorbable materials have been divided into three classes. Class 1 consists of silk, nylon, and polypropylene. Class 2 consists of cotton and linen. Class 3 consists of surgical steel. Table 3 lists

examples of the different types of materials.

Table 3. Classification of suture materials

Natural		Synthetic	
Absorbable	Non-Absorbable	Absorbable	Non-Absorbable
Catgut Chromic catgut	Silk Linen	Polyglactin (Vicryl) Monocryl Polydioxanone (PDS)	Nylon Polypropylene (Prolene)

Another method of classifying suture materials is as monofilament materials or multifilament materials. As the name suggests, monofilament suture materials have only a single strand. On the other hand, multifilament materials have several strands that are braided or twisted together. While multifilament materials have the advantage of better structural integrity, they have two disadvantages over monofilaments. Firstly, they cause additional trauma to the tissues through which they pass. Secondly, the added bulk of these materials can harbor micro-organisms, and may incite tissue reactions. Monofilaments are more difficult to handle and have poor knot security, but are associated with lower risk of infection. Silk and vicryl are available as multifilament, while most other materials are monofilament.

Suture Material Sizes

Most commonly available suture materials are available in a variety of sizes. Based on their sizes, they are assigned a number in reverse order. The higher the number of a material is, smaller is the size. Different suture sizes have different applications in surgery. These are summarized in Table 4.

Table 4. Sizes of suture materials and their applications

Size of Suture Material	Applications in Surgery
0-0 and 1-0	Closure of abdominal wall and securing drain tubes at the wound site.

2-0 and 3-0	Closure of thick tissues, including skin, fascia, muscles, and tendons.
4-0 and 5-0	Skin closure in esthetic areas including hands, feet, face, and skin closure in pediatric patients.
6-0 and 7-0	Plastic surgery and blood vessel repair.
8-0 to 11-0	Ophthalmic surgery and microsurgery including micro vascular reconstruction.

Characteristics of the Suture Material that can Affect Wound Healing Outcomes:

Since the ideal suture material does not exist, the surgeon must make an informed choice based on the characteristics of each material. The following characteristics can affect the final wound healing outcome, and must be kept in mind:

- **Tensile Strength:** Tensile strength refers to the amount of stress that any suture material can withstand before it breaks. Suture materials are prone to several stresses during suture placement, as well as in the postoperative period, owing to swelling and movement. Apart from the initial tensile strength, the rate at which tensile strength is lost over time is also important, and this must parallel an increase in wound strength. The implantation, knotting, and tying of the suture itself causes a loss in tensile strength. Tensile strength is also lost faster in a wet environment.
- **Plasticity:** Plasticity refers to the ability of a material to stretch to accommodate increase in tissue bulk. This is important as most tissues are prone to swelling after surgical manipulation. Plasticity decreases the incidence of tissue strangulation and the formation of cross hatch marks.
- **Elasticity:** Elasticity refers to the ability of a suture material to return to its original length after swelling has subsided. If a material is plastic but not elastic, the sutures may become loose after the swelling subsides. Elastic materials ensure that wound

margins remain approximated.

- **Memory:** Memory refers to the tendency of the material to return to its original form and shape after it has been bent or manipulated. A material with high memory may be stiff and difficult to handle. Tying knots with these materials can be challenging as the knot may loosen and affect the suture integrity.
- **Pliability:** Pliability refers to the degree of flexibility and the ease with which a material can be bent. Pliable materials are easier to handle and less prone to breakage than non-pliable materials.
- **Coefficient of Friction:** This refers to the degree of slipperiness of the material. A material that is slippery can be handled better and is not prone to break. Sutures with high coefficient of friction can be difficult to pull through and can traumatize the tissue.
- **Biocompatibility:** All suture materials are foreign bodies and therefore cause tissue reactions to some extent. This is greater with natural and multifilament materials. Most suture materials do not cause allergic reactions. However, chromic acids present in chromic catgut have been found to cause allergic reactions in few patients.
- **Antibacterial Activity:** Suture materials do not have intrinsic antibacterial properties. However, materials coated with antibacterial agents are available. Triclosan has been used for coating monocryl and vicryl, and has been shown to reduce colonization by staphylococcus species.

The above characteristics vary with each suture material. Each material must be chosen for specific indications based on the above characteristics. The characteristics and indications for each kind of suture material have been summarized in Table 5.

Table 5. Characteristics of commonly used suture materials

Type of Material	Material	Salient Characteristics	Applications
Absorbable	Catgut-Plain	Maintains tensile strength for 7-10 days. Gets absorbed in	Not commonly used nowadays.

		70 days. Produces marked tissue reaction. Both tensile strength and rate of absorption are not predictable.	
	Chromic Catgut	Treatment with chromic acid delays absorption which occurs around 90 days. Tensile strength lasts for 0-21 days. Can cause allergic reactions due to chromic acid.	Not commonly used, mainly for closure of mucosal wounds.
	Fast absorbing Catgut	Heat treatment facilitates rapid absorption, usually within 2-4 weeks. Tensile strength lasts for 5-7 days only.	Facial wounds, for securing skin grafts.
	Polyglycolic acid	High tensile strength initially, reduces to half by two weeks, and only 5% remains by four weeks. Absorbed in 90 to 120 days.	Closure of deeper layers.

		Easy to handle, good knot security. High coefficient of friction.	
	Coated Polyglycolic acid	Reduced coefficient of friction, but lesser knot security.	
	Fast absorbing Polyglycolic acid	Tensile strength lasts for 7-10 days. Hydrolyzed by 42 days.	
	Polyglactin 910 (Vicryl)	Easy to handle, good knot security. Tensile strength higher than polyglycolic acid, retains 60% strength at two weeks. Absorbed in 60-90 days Biocompatible, low tissue reaction.	Suturing deep tissues. Can also be used for percutaneous closure.
	Vicryl Rapide	Ionization with gamma radiation speeds its absorption, which occurs in 35 days.	Oral wounds, fast absorption minimize irritation.

	Coated Vicryl	Triclosan coating provides antibacterial activity.	Wounds at increased risk of infection.
	Polydioxanone (PDS)	Lower tensile strength than vicryl and polyglycolic acid, but it lasts longer and retains almost 75% strength at two weeks. Stiff and difficult to handle. Minimal tissue reaction.	Useful in wounds that require prolonged dermal support, which minimizes spreading of scars.
	Poliglecaprone (Monocryl)	Highest tensile strength, which decreases rapidly to only 30% by day 14. Pliable, easy to handle, good knot security.	Useful as buried suture where dermal support is not needed.
	Coated Monocryl	Triclosan coating provides antibacterial action.	Areas more prone to infection
Non-Absorbable	Silk	Excellent handling, high knot security. Low tensile strength.	Securing drains. Temporary stay suture to elevate or

		High tissue reactivity.	retract tissues during surgery.
	Nylon	High tensile strength which reduces marginally over time. Gradually absorbs over several years. Stiff, difficult to handle, can traumatize friable tissues. Low knot security. Low tissue reactivity.	Skin sutures. Buried sutures which require prolonged dermal support.
	Polypropylene (Prolene)	Lower tensile strength than nylon. Extremely low tissue reactivity. Does not resorb at all over time. Stiff material, poor handling and knot security. Low coefficient of friction. High plasticity, and can accommodate swelling.	Skin sutures. Areas where more swelling is anticipated. Buried sutures needing long-term dermal support.

HAND INSTRUMENTS

The needle and suture material need to be controlled and manipulated by certain instruments for placing them into and withdrawing them from the tissue. The most basic instruments needed for suturing include needle holder, tissue forceps, and scissors.

Needle Holder

This instrument is used for holding the needle during suturing. It also assists in placement of the knot in certain techniques. The instrument consists of a locking handle, and a short blunt beak. It is easy to confuse this instrument with a hemostat (or artery forceps), which also has a locking handle. However, the needle holder has a shorter beak. The internal face of the needle holder has cross-hatches and a longitudinal groove in the center, which permits a secure grip on the needle. On the other hand, the hemostat has parallel, horizontal grooves that do not permit a proper grip on the needle. The handle of the needle holder may be short or long. Long handles are useful for suturing at depth. Short handles are useful when delicate, fine suturing is required.

To hold the needle holder properly, follow the steps given below:

1. Insert the thumb and ring finger of your dominant hand into the rings of the needle holder. Do not insert the entire finger; only the distal phalanges must remain inside the ring.
2. The index finger may be used to stabilize the needle holder by placing it over the joint. By doing this, the index finger can control the direction of movement of the needle holder.
3. Grasp the needle within the beaks of the needle holder such that it lies one-third the distance from the eye, and two-thirds from the tip. The needle must be held perpendicular to the beaks.
4. Once the needle has been grasped, press the ratchet lock on the handle to secure it.
5. The needle must be removed from the holder prior to tying the knot.

Another method of holding the needle holder is by ‘palming’ it. In this method, the thumb and ring fingers do not engage the rings of the needle holder. Instead, the thumb rests on the shaft of the instrument on one side, and the ring finger, along with the middle and little fingers, is wrapped around the instrument shaft on the other side. The thenar eminence is used to

control the ratchet lock mechanism of the needle holder.

Tissue Forceps

Tissue forceps are also known as ‘pickups’. They are used to grasp or stabilize the wound edges while suturing. While there are many different kinds of tissue forceps, Adson forceps are most commonly used for suturing. The forceps may or may not have small teeth at the tips. Toothed forceps provide a better grip, but at the same time may traumatize delicate tissues. In general, toothed forceps must be used for tough tissues such as fascia or skin, while non-toothed forceps must be used for more delicate tissues such as bowel and blood vessels. The tissue forceps must be held between the thumb and the index and middle fingers, similar to a pen grasp. The tissues must be ‘picked’ up gently. Never crush the tissues.

Scissors

A pair of scissors is needed to cut the sutures after the knot has been placed. Suture cutting scissors should ideally have short beaks and long handles. Scissors must be held in a similar manner as the needle holder, inserting the thumb and ring fingers into the rings of the handle, and using the index finger for stability. The index finger of opposite hand may be used as a rest if sutures are required to be cut at depth. Remember to always cut with the tips of the scissors rather than the flat end of the blade. This gives more accuracy and can avoid unnecessary trauma to the tissues.

Maintaining Sterility of the Armamentarium

All materials and instruments that are used for suturing must be maintained in sterile conditions, and suturing must be done under aseptic conditions to prevent wound contamination. Different components of the armamentarium may be sterilized by different means.

- Suture Materials and Needles: Swaged needles and materials are usually available in a sterile package. The method used is usually ethylene oxide sterilization, and you will find that each suture pack has a label that confirms that the material is EO-sterile. Eyed needles and running suture materials such as silk must be threaded, prior to sterilization. These are then usually sterilized by autoclaving. Bear in mind that repeated autoclaving can compromise the structural integrity of the suture materials.

- Instruments: Instruments used in suturing, namely the needle holder, toothed forceps, and scissors, are also usually sterilized in an autoclave. The suturing kit must either be packed separately, or as part of the surgical kit prior to autoclaving.

All sterile materials and instruments must be handled only with sterile gloved hands. When the floor nurse dispenses sterile suture material, he/she must peel the unsterile outer covering off carefully, and allow it to drop on to the instrument table.

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SELF ASSESSMENT

1. Which of the following suture material sizes is useful in microsurgery?

a. 2-0
b. 4-0
c. 6-0
d. 10-0

2. Which of the following needle types is suitable for delicate, friable tissue?

a. Cutting

b. Reverse cutting
c. Round body taper
d. Round body blunt tip

3. Which of the following does not improve the handling characteristics of the suture material?

a. High coefficient of friction

b. Low coefficient of friction
c. Pliability
d. Flexibility

4. Which of the following properties a material must possess in order to prevent sutures from becoming loose?

a. Plasticity

b. Elasticity
c. Memory
d. Pliability

5. Which of the following suture materials is not suitable when prolonged dermal support is required?

a. Nylon

b. Polypropylene
c. Poliglecaprone
d. Polydioxanone

6. Which of the following suture materials is suitable in areas that are prone to develop swelling?

a. Nylon

b. Polypropylene
c. Polydioxanone
d. Polyglactin

7. Which of the following materials is prone to cause inflammatory reactions?

a. Polydioxanone

b. Catgut
c. Nylon
d. Polyglycolic acid

8. What is the antimicrobial agent used in coated polyglactin?

a. Chlorhexidine

b. Penicillin
c. Metronidazole
d. Triclosan

9. Which of the following is the correct method of placing the needle in the needle holder?

a. At the eye

b. One-third distance from the eye
c. Half the distance from the eye
d. Two-thirds distance from the eye

10. Which of the following suture materials takes the longest time to get absorbed?

a. Catgut

b. Polyglycolic acid
c. Polyglactin
d. Polydioxanone

CHAPTER 2

Purpose and Basic Principles of Suturing

While suturing is a useful and commonly used surgical technique, it is important to know when exactly sutures are needed and when they can be avoided. This chapter will cover the indications and goals of suturing, and outline the basic principles that need to be followed during the placement of any kind of suture.

Goals of Suturing:

- To approximate two edges of the wound so that they remain in contact with each other and facilitate primary healing.
- To support the wound and provide it with tensile strength until the wound develops its own inherent tensile strength by the healing process.
- To eliminate any dead spaces between wound layers.
- To minimize the risk of bleeding.
- To minimize the risk of infection.

Indications for Placing Sutures

- To close wounds unless contraindicated.
- To secure flaps at the recipient site.
- To repair congenital defects such as cleft lip.
- To ligate and transfix blood vessels in order to achieve hemostasis.
- To join two blood vessels together, for the purpose of directing blood flow to a new anatomical site.
- To repair severed nerves and tendons.
- To secure drains, tracheostomy, nasogastric, and gastrostomy tubes.
- To retract tissues to improve access and visibility.

Contraindications for Sutures

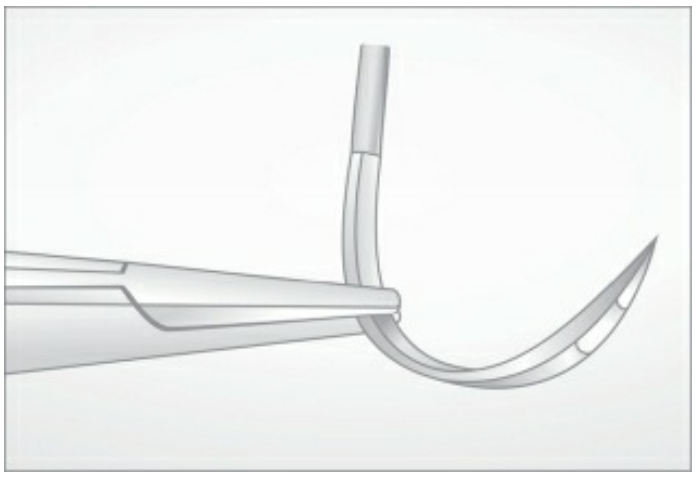
- When the wound is superficial and does not gape.
- Wounds on concave surfaces, such as the nasal alar crease and the preauricular sulcus.
- Wounds that are infected must not be sutured unless the infection has been controlled.

Basic Principles of Suturing

Irrespective of the purpose of suturing, certain basic principles have to be followed while placing a suture. While learning how to suture for the first time as a student, attention is paid carefully to these principles in order to place a secure suture. Over time, these become second nature to most of us.

Principles of using the armamentarium:

- Prior to suturing, ensure that the needle and suture material are being held correctly.
- Hold the needle holder in your dominant hand, as described in the previous chapter, between the thumb and ring fingers.
- Place the needle in the jaws of the needle holder at right angles to it, both vertically and horizontally.
- The needle should be held such that it lies in the holder at a point that is one-third the distance from the end (or eye), and two-thirds from the tip.
- Hold the tissue forceps in your non-dominant hand, using a pen grasp.



Principles of Taking the ‘Bite’

The process of inserting the needle into the tissue and withdrawing it is referred to as a ‘bite’. To do this correctly, follow the principles given below.

- Use the tissue forceps to pick up the first wound edge, and evert it gently. This will allow you to visualize the needle as it exits from the opposite side.
- Use the needle to pierce the tissue on one side of the wound. The ideal distance for entering the tissue is around 5mm from the wound edge.
- The needle must enter the tissue at right angles to the wound surface. This allows it to penetrate the wound better, and in an atraumatic fashion.
- Once the needle enters, you must push the needle further into the tissue. While doing so, try to push it following the natural curvature of the needle. This is atraumatic and also provides least resistance from the tissue.
- You will see the needle exit on the inner side of the tissue. Release the needle holder from the ‘entering’ end of the needle, and use it to instead grasp the ‘emerging’ end of the needle.
- Pull the needle, with the attached suture material out of the inner wound edge, again following the natural needle curvature.
- Now the bite must be taken through the second wound edge. Take the bite at the inner edge of the second side (this may vary depending on the technique chosen).
- Follow the same principles given above for entering and exiting the second wound edge.
- Remember that the distance of the bites taken on both sides of the wound must be equal. Therefore, if the first bite was taken 5mm from the wound edge, the second bite must also have an exit that is 5mm from the wound edge.
- Never be tempted to take both bites at once. Taking each bite separately improves the accuracy and saves time in the long run.
- Similarly, the depth of the bite must be equal on both sides. If the first bite is taken through the skin and subcutaneous tissue, the second bite must be taken from the subcutaneous tissue at the same depth, out through the skin. However, there are certain exceptions to this principle. For instance, a technique referred to

as the dermal-subdermal suture technique involves suturing two different layers and therefore different bite depths.

- Sutures are usually placed from the edge away from you, to the edge towards you. They can also be placed from your dominant side to your non-dominant side. These methods provide the most comfort while suturing. However, the following rules must be kept in mind while taking bites:
    - Always suture from movable tissues to fixed tissues.
    - Suture from thinner tissues to thicker tissues.
    - Suture from deeper tissues to more superficial tissues.

Principles of Placing the Knot

The actual process of knot tying has a separate set of principles, which will be described in a later chapter. However, certain principles need to be kept in mind during this phase of the suturing.

- Once the needle exits the second wound edge, pull the suture material out of the second wound edge, until only a short length of material remains at the entry point on the first edge.
- Unclip the needle holder. Setting the tissue forceps aside, collect the long end of the suture material in your non-dominant hand.
- Knots can be placed either by hand, or using the needle holder. If the needle holder is to be used, grasp it in the dominant hand, and hold it parallel to the wound margin.
- Place the knot according to the technique desired. The techniques for knot placement are described in the next chapter.
- The knots must be tight enough to provide adequate security to the suture, and to approximate the wound edges.
- The knot, however, must not be so tight that it causes strangulation of the wound, or cuts off blood supply.
- The knot must never lie directly on the wound, as this may interfere with wound healing. It must lie on one side of the wound. If multiple knots are going to be placed, as is the case with interrupted sutures, it is best to place all knots on the same side of the suture line.

Principles of Cutting the Suture

- Ensure that the scissors used for suture cutting are sharp. Blunt scissors can cause fraying of the suture material, which reduces its integrity for the next suture.
- Cut off either one or both ends of the suture as desired according to the technique. For running sutures, only the short end must be cut off, while for interrupted sutures, both ends are cut off.
- For buried sutures placed with absorbable material, cut the sutures as close to the knot as possible. Do not, however, cut right at the knot as this may inadvertently cause knot breakage and compromise the entire suture.
- For surface sutures that are placed with non-absorbable sutures, do not cut the knot too short. Ideally, at least 5mm of material must be left. This is to facilitate grasping and lifting the material during suture removal.

References

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SELF ASSESSMENT

1. At which point must the needle be held in the needle holder?

a. 2/3 distance from eye

b. 2/3 distance from end
c. Half the distance from eye and end
d. 1/3 distance from eye

2. In which of the following situations is suturing contraindicated?

a. Repairing cleft lip

b. Closing wounds at nasal alar crease
c. Securing drains
d. Repairing nerves

3. Which of the following is the correct method of suturing?

a. Fixed to movable tissue

b. Superficial to deep tissue
c. Movable to fixed tissue
d. Thick to thin tissue

4. What is the ideal distance of taking a bite form the wound edge?

a. 2 mm

b. 5 mm
c. 10 mm
d. 3 mm

5. How should the suture needle enter and exit the tissue?

a. In a single straight line

b. Along the curvature of the needle
c. Along the contour of the wound
d. Parallel to the wound