SUTURING WITH INSTRUMENTS

A Basic Manual For Skin Suturing

Gayan Ekanayake

SUTURING IS AN ART THAT CAN BE MASTERED WHEN YOU LEARN TO RESPECT TISSUES

SUTURING WITH INSTRUMENTS

A BASIC MANUAL FOR SUTURING

3rd Edition

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Introduction

Suturing is a fundamental skill in medical practice, essential for closing wounds and incisions to promote healing and minimize scarring. Dating back thousands of years, the technique has evolved significantly, with various materials and methods developed to achieve optimal wound closure.

At its core, suturing involves using a needle and thread to sew tissues together. The process requires precision, dexterity, and understanding of wound anatomy to ensure proper alignment and tension.

The primary goals of suturing include:

1. Wound Closure: Suturing brings wound edges together, facilitating the natural healing process by reducing the risk of infection and promoting tissue approximation.
2. Hemostasis: Sutures can help control bleeding by applying pressure to blood vessels within the wound, minimizing blood loss.
3. Tissue Approximation: Properly aligned and tensioned sutures ensure that tissue layers are in close contact, which is vital for optimal healing and reducing the risk of complications such as dehiscence (wound reopening).
4. Cosmetic Outcome: Suturing techniques also play a role in achieving favorable cosmetic results, minimizing scarring and distortion of tissue.

Suturing materials vary based on factors such as the location and type of wound, as well as individual patient characteristics. Common types of sutures include absorbable and non-absorbable materials, each with its advantages and indications.

There exist numerous types of sutures categorized based on various characteristics. Understanding these characteristics is crucial for optimal suture selection. The primary factors used for classifying suture types include:

- Absorbable versus non-absorbable
- Synthetic versus natural
- Monofilament versus multifilament

The primary category of sutures is absorbable versus non-absorbable. Sutures are deemed absorbable if they lose most of their tensile strength over variable periods, ranging from a few weeks to several months. Absorbable sutures are typically employed for temporary deep closure until tissues heal or in situations where removal would be difficult. They are beneficial for approximating tissue layers, closing deep spaces or defects, and aiding wound healing in multi-layered closures. However, superficial use of absorbable sutures may lead to increased inflammation and scarring, thus it is recommended to use rapidly absorbing sutures in such cases.

Absorbable sutures can further be classified as natural or synthetic. Natural sutures are derived from purified animal tissues, usually collagen, and sometimes from the purified serosa of bovine intestines. Examples include silk and catgut (made from sheep sub mucosa). Natural sutures differ from synthetic sutures in their degradation process; natural sutures degrade via proteolysis (in the case of absorbable ones like catgut), while synthetic sutures degrade via hydrolysis. Hydrolysis typically induces a milder inflammatory reaction compared to proteolysis, which is why natural sutures are associated with more inflammation at the suture site. Catgut sutures can be strengthened using an aldehyde solution (plain catgut) or further treated with chromium trioxide (chromic catgut) to enhance durability before absorption.

Non-absorbable sutures are utilized for long-term tissue closure, such as vessel anastomosis, permanent ligation of internal tubular structures or vessels, secondary layers in bowel anastomosis, closure of hernia fascial defects, among other applications.

Another significant classification of sutures is monofilament versus multifilament. Monofilament sutures consist of single filaments, as indicated by their name, possessing less surface area compared to multifilament (braided or twisted) sutures. Monofilament sutures exhibit higher memory, requiring more careful handling. Memory refers to the tendency of a suture to revert to its original shape, making it more prone to knot loosening. This issue can be addressed by gently tugging the suture after tying knots. While monofilament sutures typically necessitate more knots for security, they tend to fracture less frequently than multifilament sutures. Moreover, monofilament sutures pass through tissues more smoothly and evoke a less inflammatory reaction compared to their multifilament counterparts.

Conversely, multifilament sutures are more pliable, securely holding knots, exhibiting less memory, and being easier for surgeons to handle. However, they generate more friction through tissue, possess increased capillarity and surface area, thus elevating the risk of inflammation and infection. Multifilament sutures can be coated to enhance tissue glide and mimic monofilament sutures' properties. They can also be imbued with antibiotics for enhanced infection resistance, albeit at a higher cost compared to traditional sutures.

Dyes can be added to any suture to aid visualization, but it's preferable for sutures placed under the epidermis to remain undyed to avoid visibility. While most sutures feature smooth surfaces, newer iterations come with barbs, aiding wound approximation without the need for knots and facilitating more even tension distribution along the wound. Barbed sutures are also noted for their time efficiency.

Another crucial aspect of sutures is their tensile or breaking strength, primarily determined by suture width. Sutures are numbered based on their size relative to their diameter, with thicker sutures numbered from 0 to 10 (with #10 being the largest diameter) and thinner sutures designated with increasing numbers of zeroes, ranging from 1-0 to 12-0 (with 12-0 having the least breaking strength). The diameter difference between sizes typically ranges from 0.01 to 0.05 mm.

The subsequent significant element regarding sutures revolves around the needle. Since the 18th century, hollow needles have served as medical instruments, and the advancement of modern bioengineering has given rise to a two-part disposable system comprising syringes and needles

(Chavan et al., 2013). The contemporary needle owes its design to medical-grade stainless-steel tubing, ensuring chemical resistance, which is affixed to a plastic polypropylene body (Kucklick, 2012).[1]

Comprised of three primary components—the eye, body, and point—the needle serves as a pivotal instrument in surgical stitching. The eye serves as the attachment point for the suture, either in the form of a literal aperture through which the string is threaded or a location where the suture thread is swaged onto the needle, a design more common in modern needles. The body, constituting the bulk of the needle, links the eye to the point and dictates the needle's shape. Needles can either be straight or curved, with the latter being more prevalent. Curved needles vary in the length of their curvature, typically measured as fractions of a circle such as 1/4, 1/2, 3/8, or 1/3. This curvature is instrumental in assisting surgeons in maintaining awareness of the needle tip's position throughout procedures. Most skin closure sutures utilize curved needles, commonly of the 3/8 circle variety.

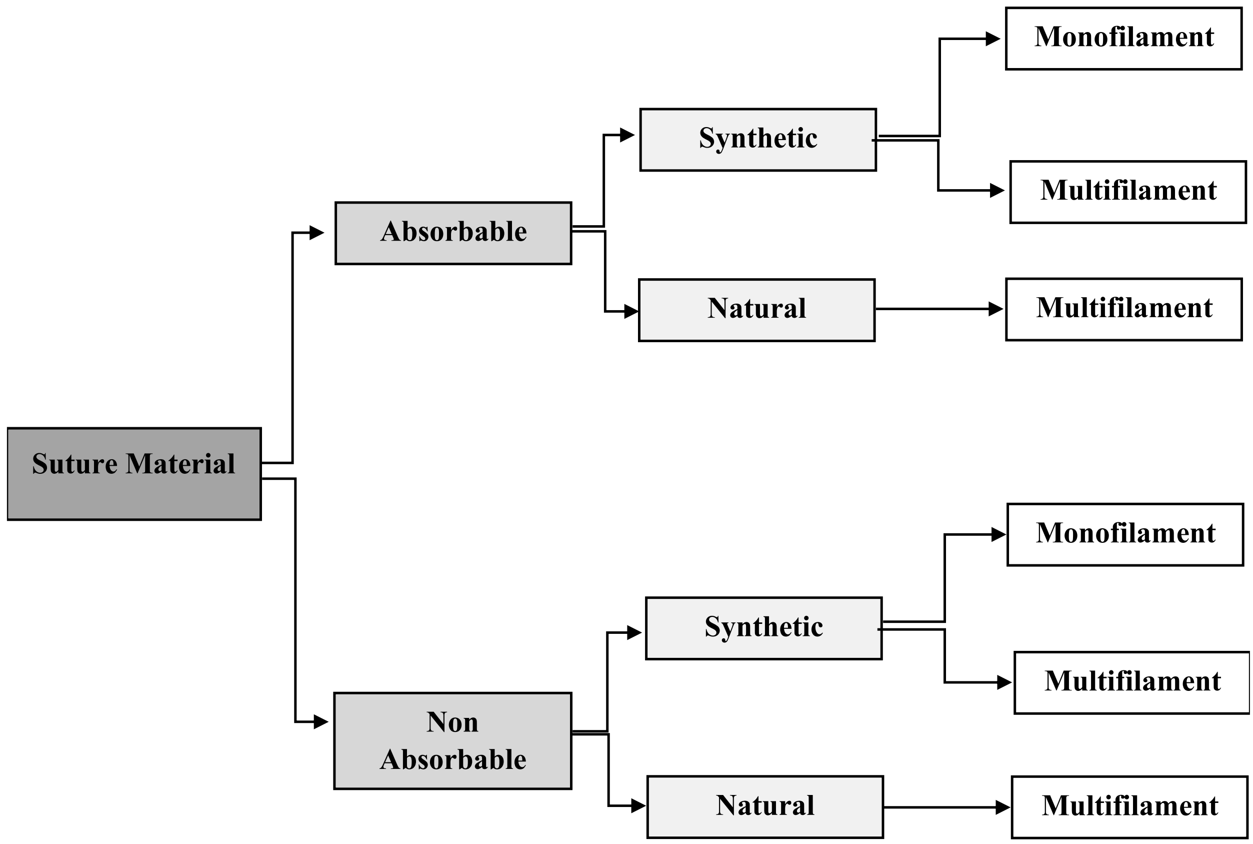
Needles also vary based on their tip type, predominantly falling into cutting or taper categories. Cutting needles feature a tip with three sharp edges, with conventional cutting needles having the cutting surface on the inside and reverse cutting needles featuring it on the outside. Reverse cutting needles are frequently employed in skin suturing applications. In contrast, taper needles possess rounded tips and can be either sharp or blunt. These needles function by piercing tissues without incising them, essentially spreading the tissue as they pass through. They prove particularly effective for delicate tissues and tendon repair.

Proficiency in suturing is typically acquired through hands-on training, often starting with basic techniques on simulated models before progressing to more complex procedures under supervision. Continuous practice and refinement of technique are essential for mastering this skill.

While suturing is a cornerstone of surgical practice, advancements in technology have introduced alternative methods such as staples, adhesive tapes, and tissue adhesives. However, suturing remains indispensable in many scenarios due to its versatility, reliability, and ability to achieve precise tissue approximation.

This guidebook provides a comprehensive walkthrough of the fundamental suturing techniques, including instrument handling and the selection of appropriate suture materials for various scenarios. It draws upon insights gleaned from multiple sources, incorporating clear and easily comprehensible illustrations to facilitate your understanding. Delving into intricate details, this resource serves as an initial foray into the art and science of suturing, laying a solid foundation for further exploration and mastery.

Types of sutures



Absorbable Sutures




Material	Polyglycolic acid	Polydioxanone	Chromic catgut	Plain catgut
Structure	Braided	Monofilament	Twisted	Twisted
Colour	Violet or Undyed	Violet	Brown	Yellow
Feature	Absorbable	Absorbable	Absorbable	Absorbable
Code	PGA	PDO	CC	PC

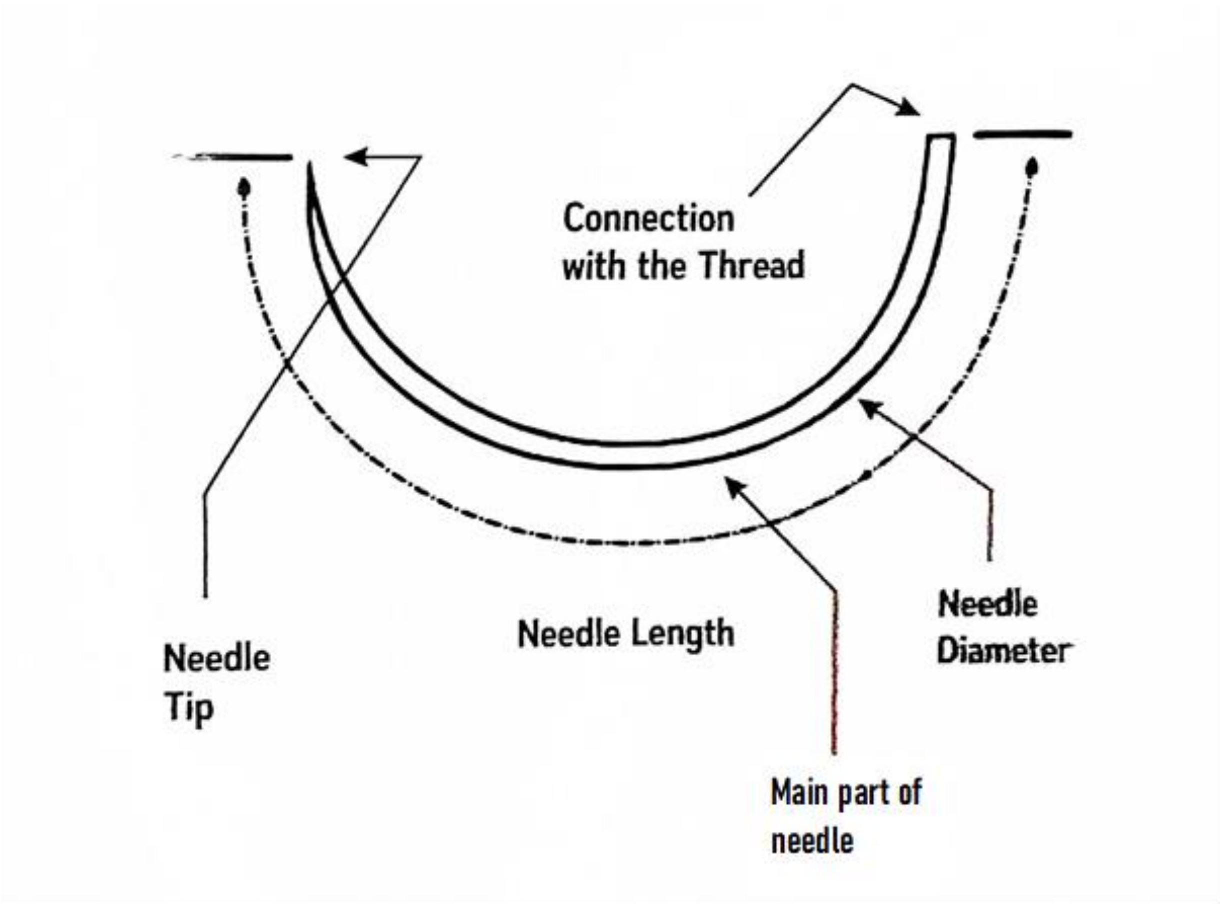
Non-absorbable Sutures



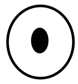
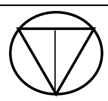
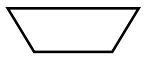
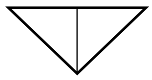
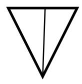
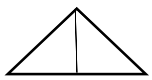
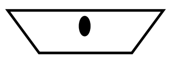
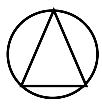

Material	Polypropelene	Polyester	Nylon	Silk
Structure	Monofilament	Braided	Monofilament	Braided
Colour	Blue	Green or White	Black or Blue	Black or Blue
Feature	Non-absorbable	Non-absorbable	Non-absorbable	Non-absorbable
Code	PP	PB	NL	SK

Needles

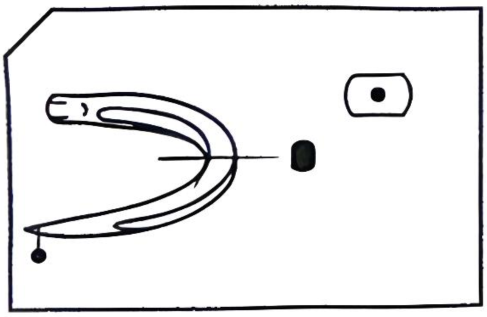
Parts of a needle



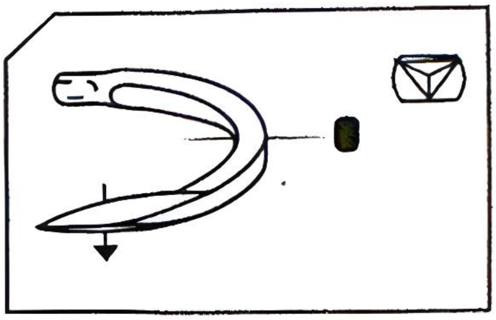
Selection of a needle tip

Blade Type	Point shape	Uses
Taper point • Dilates rather than cuts.		Aponeurosis, Dura, fascia, muscle, nerve, subcutaneous fat, vessels.
Taper cut • Ideal in tough or calcified tissues		Ligament, nasal cavity, oral cavity, vessels
Spatula		Cornea, sclera
Reverse cutting • Cuts rather than dilates. • Very sharp		Fascia, ligament, nasal cavity, oral mucosa, pharynx, skin, tendon sheath
Prime reverse cutting		Eye, microsurgery, ophthalmic (reconstructive)
Prime conventional cutting • Cuts rather than dilates. • Creates weakness allowing suture tear out. • Very sharp		Skin, fascia, muscle
Centrepoint spatula		Eye, microsurgery, ophthalmic (reconstructive)
Trocar point • Produces smallest holes of all needles		For leak proof suture line

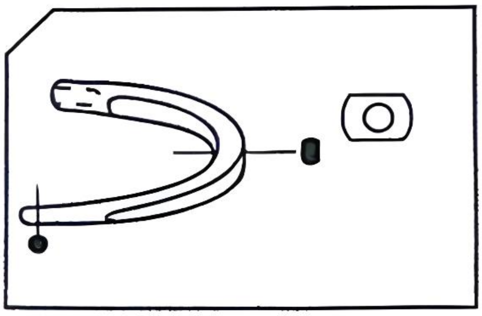
Types of needles



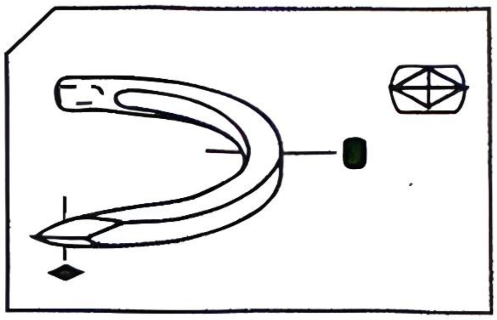
Round Needle



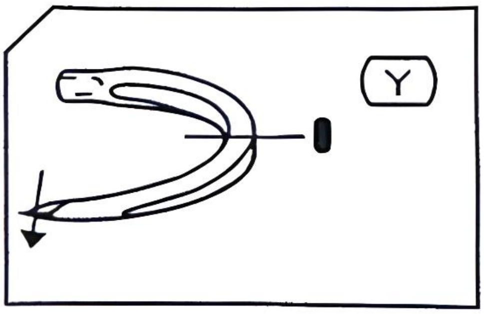
Round Cutting Needle (Sharoened)



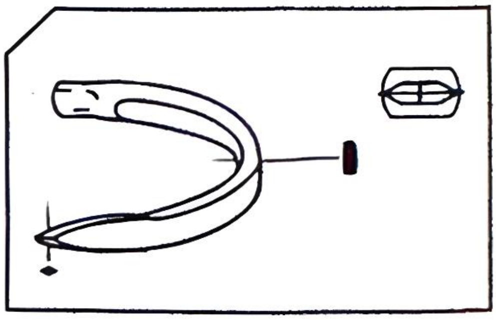
Round Blunt Needle



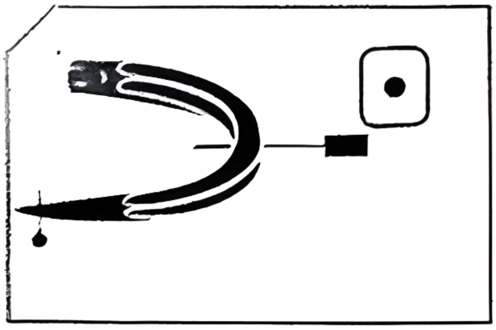
Round Needle with a Trocar Edge



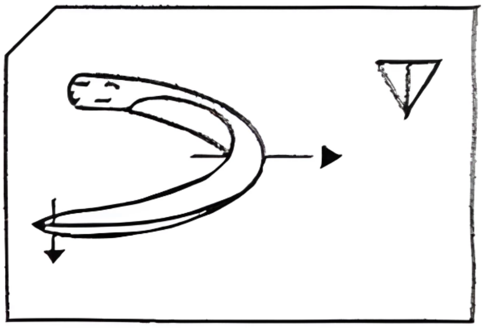
Round Needle with a Cutting Edge (Sharpened)



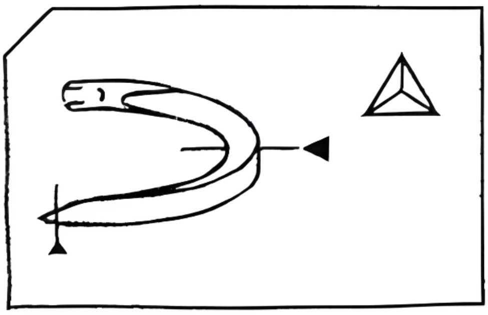
Round Separating Needle



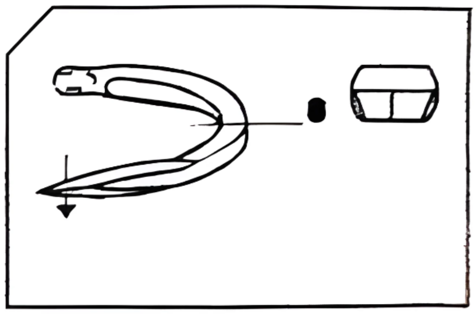
Black Needle



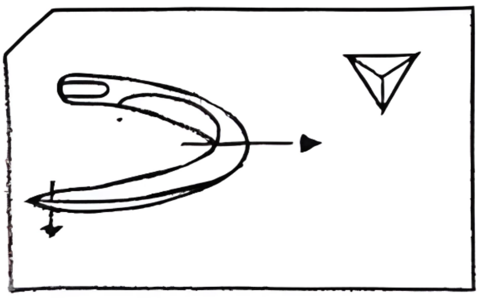
Plastic Reverse Cutting Needle with Precise Blade



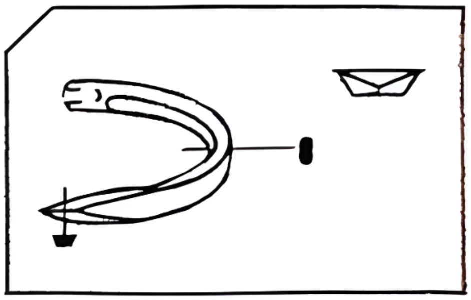
Cutting Needle



Reverse Cutting Blade Needle



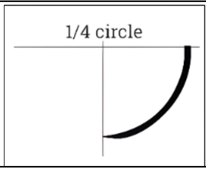
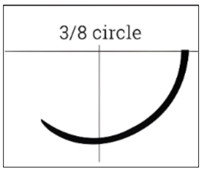
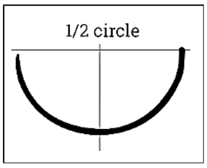
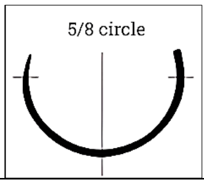
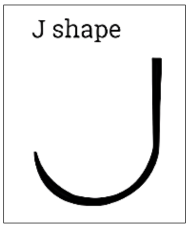
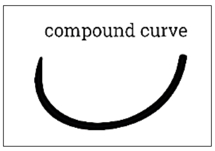
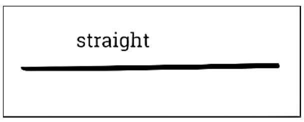
Reverse Cutting Needle



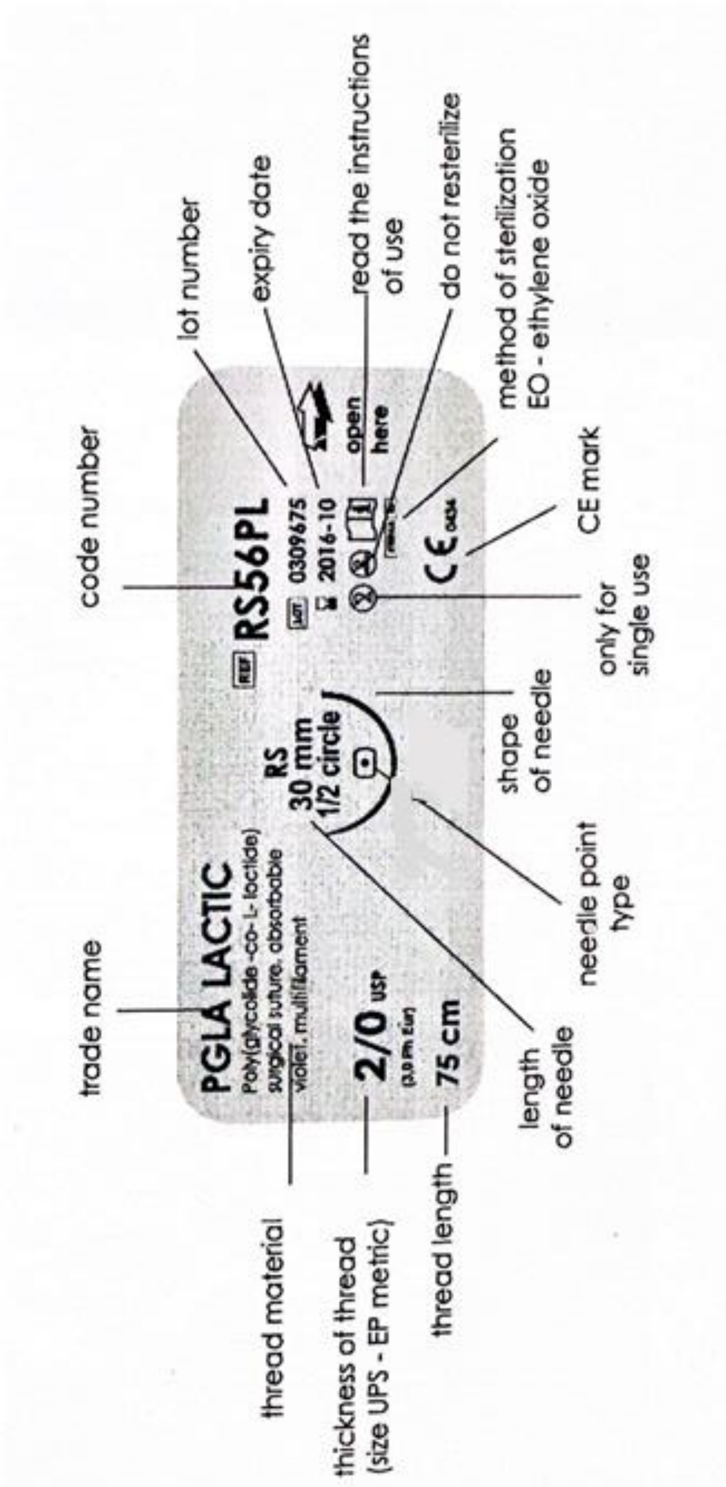
Spatula

Needle body types

The body of the needle is the portion which is grasped by the needle holder during the surgical procedure. The body of the needle should be as close as possible to the diameter of the suture material to minimize bleeding and leakage.

Needle body curve types	Uses
	• Eye • Microsurgery
	• Skin • Fascia • Nerve • Tendon
	• Muscle • Eye • Skin • Peritoneum
	• Cardiovascular • Oral Cavity • Skin • Urogenital tract
	• Laparoscopy
	• Eye
	• Nasal Cavity • Skin

Needle pack description



Surgical Instruments

Instrument holding techniques

Elbow Surgeon

Holding the needle holder is a personal choice between several grips. One of the commonest primary grips is holding the instrument without putting the fingers into the rings. This gives a very firm grip and control to the needle holder. However, the primary movement is the elbow supination and pronation, which is restricted to single plane suturing. There is one specific needle holder designed for this purpose by Sir Harrold Gillies. This is called the Gillies Needle Holder. The disadvantage of this primary grip is that the movement of the forearm will not allow the Surgeon to use a microscope or fine instruments.

Wrist Surgeon

Another popular grip is the wrist surgeon's grip. This utilizes all the possible movements of the wrist. It requires the instrument to be held by placing fingers inside loops of the needle holder, particularly the thumb and the ring finger. This grip can be combined with the elbow movement to give more range of motion when reaching the site of suturing. The ratchet is a useful adjunct to most of the needle holders when the surgeon wants the needle to be more stable. It provides a locking mechanism, however, the force which the surgeon applies the ratchet mechanism equals the distraction force on the jaws. This may lead to widening of the jaws and subsequently failing in gripping needles due to ratchet dysfunction. The needle holders can last for longer period by practicing non-clamping ratchet technique or using single click mechanism.

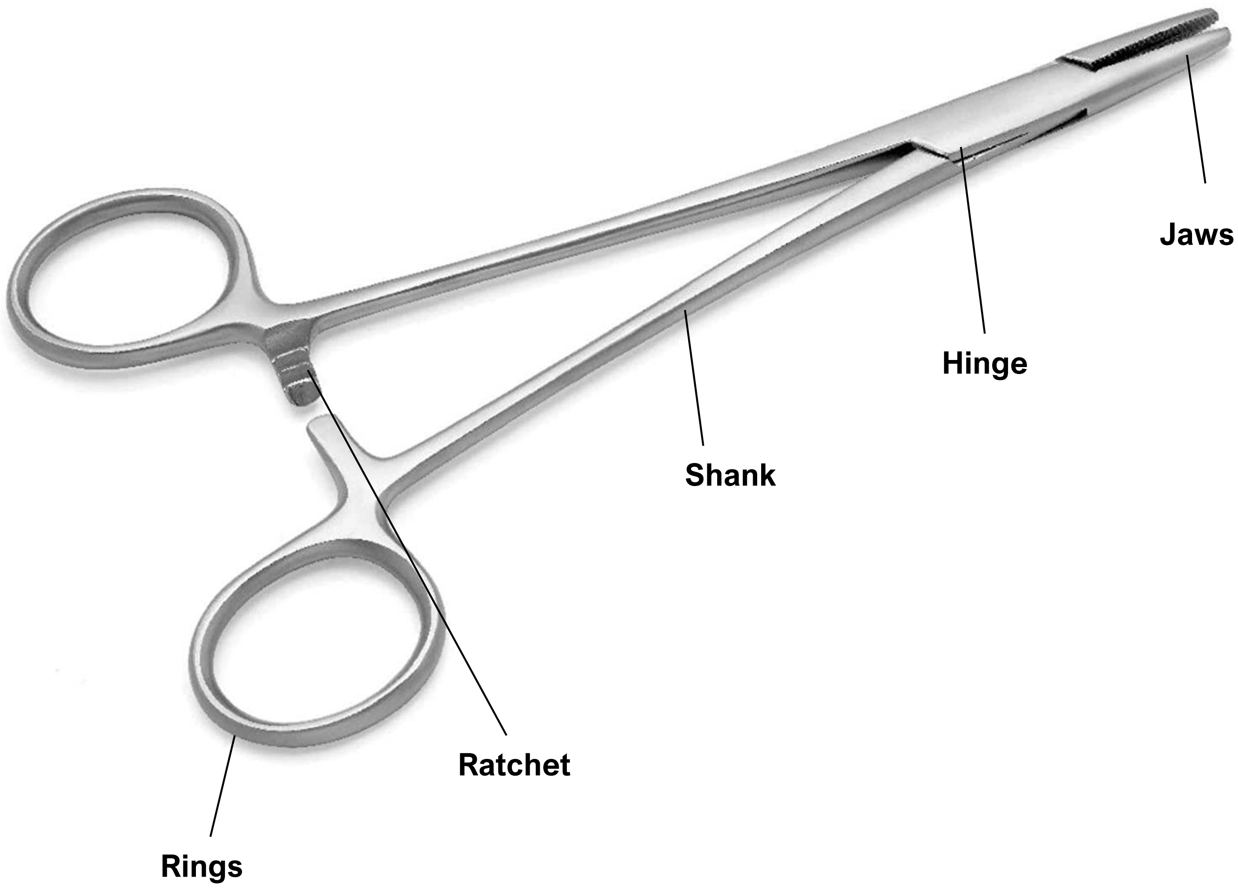
Metacarpal Surgeon

One of the most innovative discoveries was metacarpal movement-based suturing. This was discovered by Robert D. Acland in the 1960's. This revolutionized precise placement of sutures to anastomose smaller vessels. In addition, this discovery was monumental in microsurgery. Surgeons could now operate while keeping the wrist stable on a platform using needle holders with tips less than 1 mm. The needles and sutures that could be held with these instruments are in the range of 8/0 to 12/0.

Phalangeal Surgeon

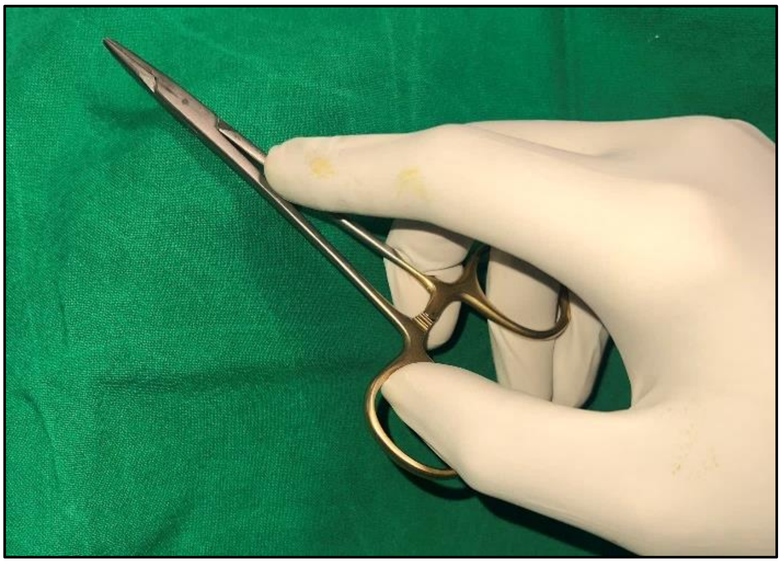
Although this technique is beyond the scope of this book, it is worth mentioning that sutures beyond 13/0 is now very popular among plastic surgeons particularly in lymphatic anastomoses. This are considered as super microsurgery which operates on vessels less than 0.7 mm in diameter. This basically involves using extra delicate light weight instruments that can hold these needles. These needles are guided through the movement of only phalanges.

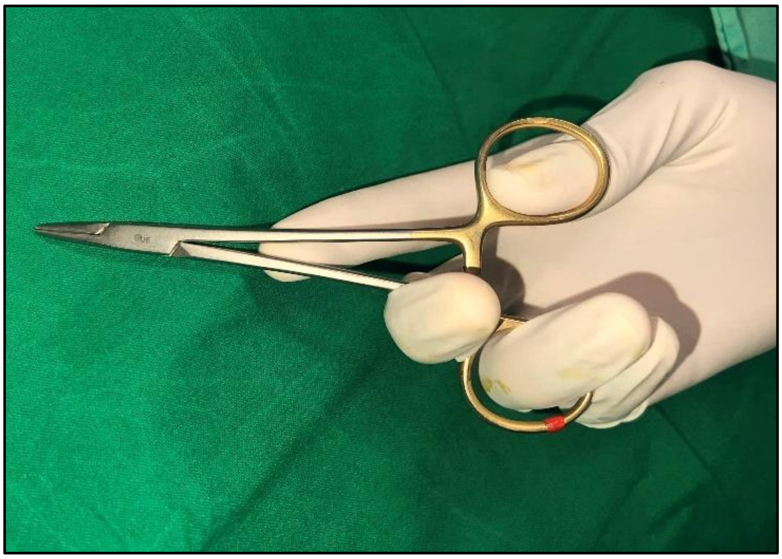
Needle Holder



Technique of holding the needle holder

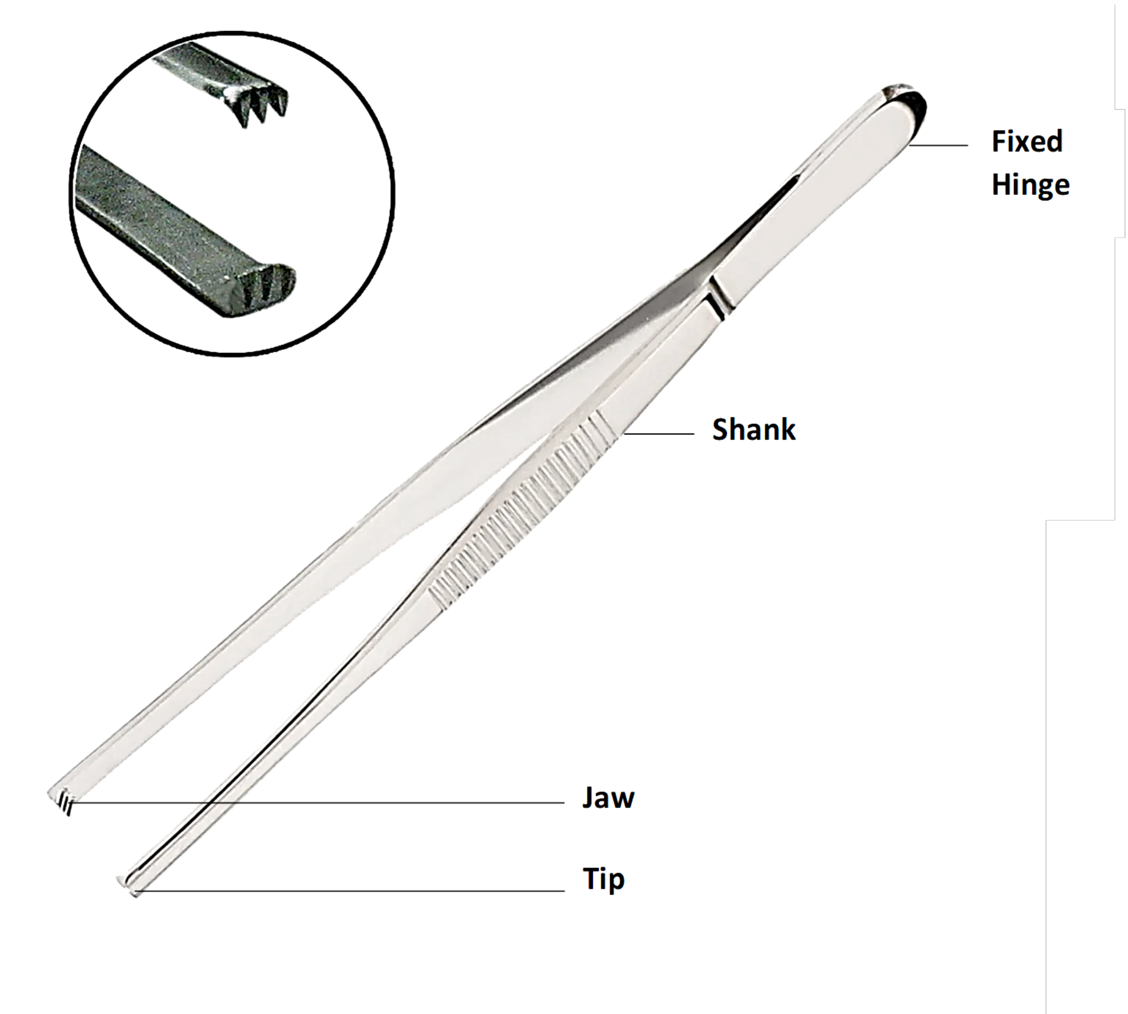
- Place your thumb and ring finger in the rings.
- Grab the needle until you hear the clasp engaged, ensuring that the needle is securely held.
- Grab the needle at its half-way point, with the tip pointing upward.
- Try not to grab the tip; it will become blunt making it difficult to pass the tip through the skin.
- The needle should be held in the tip of jaws of the needle holder, preferably at the mid body.





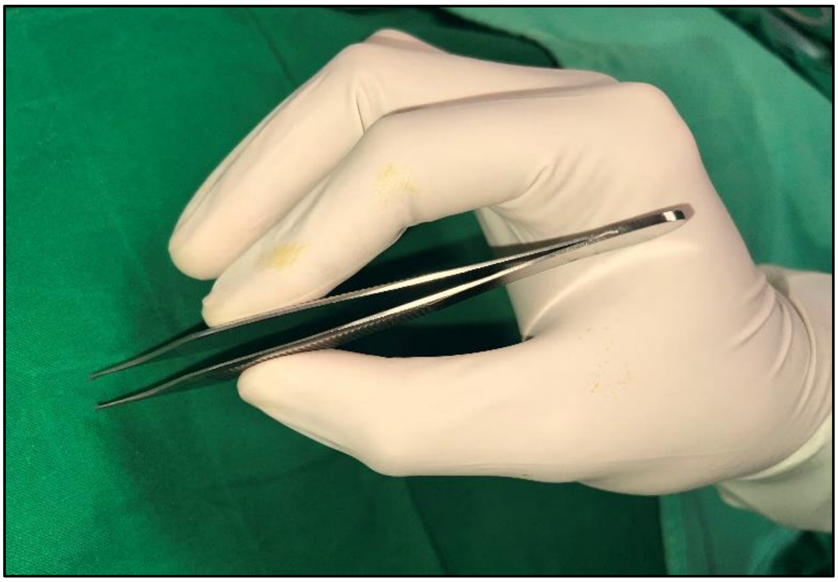
Forceps

There are several types of tissue forceps available. The commonest type is McIndoe toothed forceps. The other commonly used forceps are Adson, Adson Brown and De Bakey. Other smaller more specific forceps are used in microsurgery and vascular surgery.

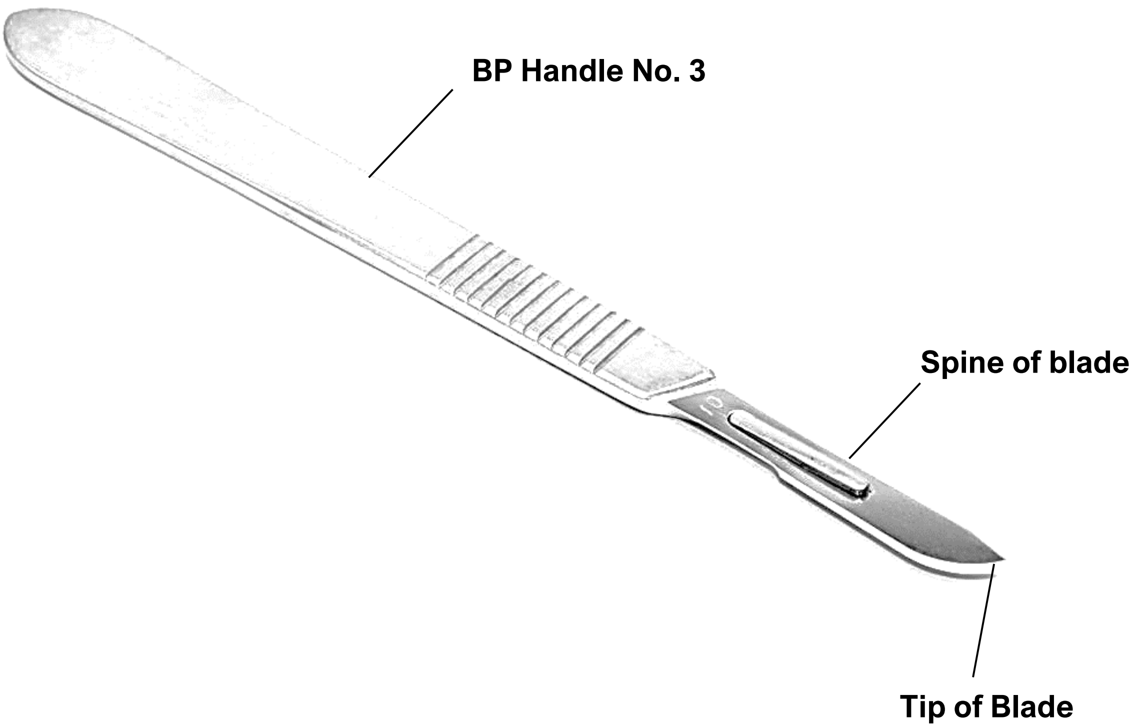


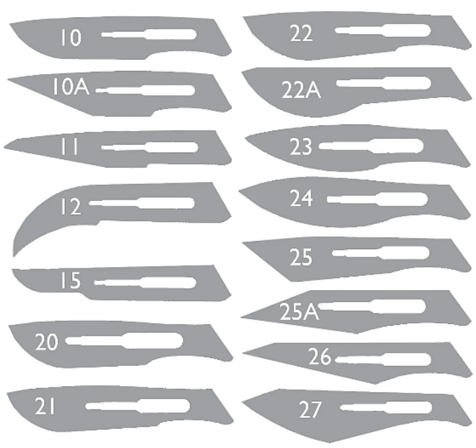
Technique of holding the forceps

Hold the forceps like a pencil. Forceps will help you to place the needle at the desired place since the skin is mobile. Do not grab the skin tightly as it can leave marks. Using a fine-toothed forceps prevents crushing the skin between blades. Use the teeth to lift till the needle enters the epidermis (first bite) or the dermis (exit bite). Use the opposite tip to counter pressure the skin.

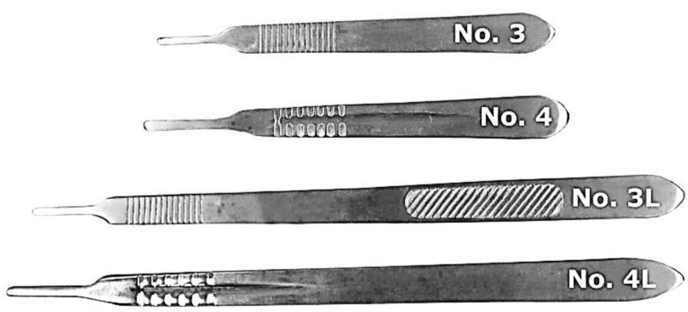


Scalpel





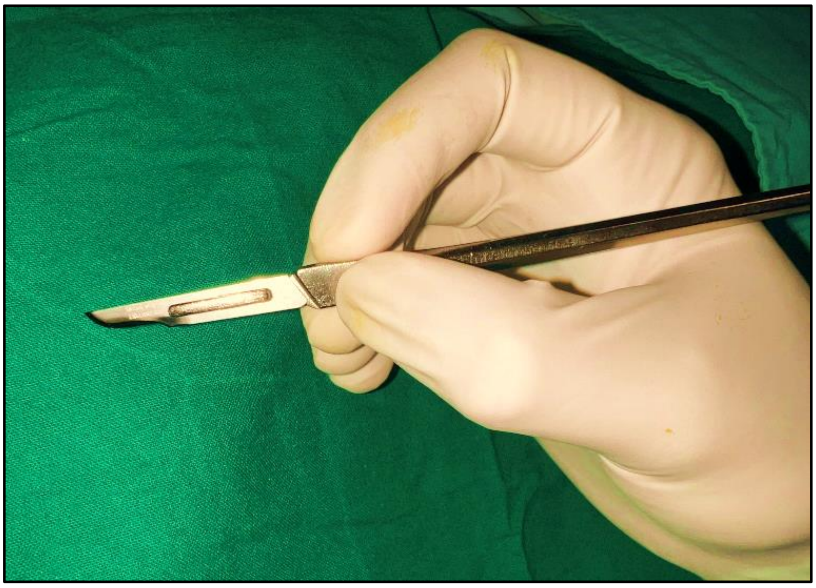
Blade Sizes



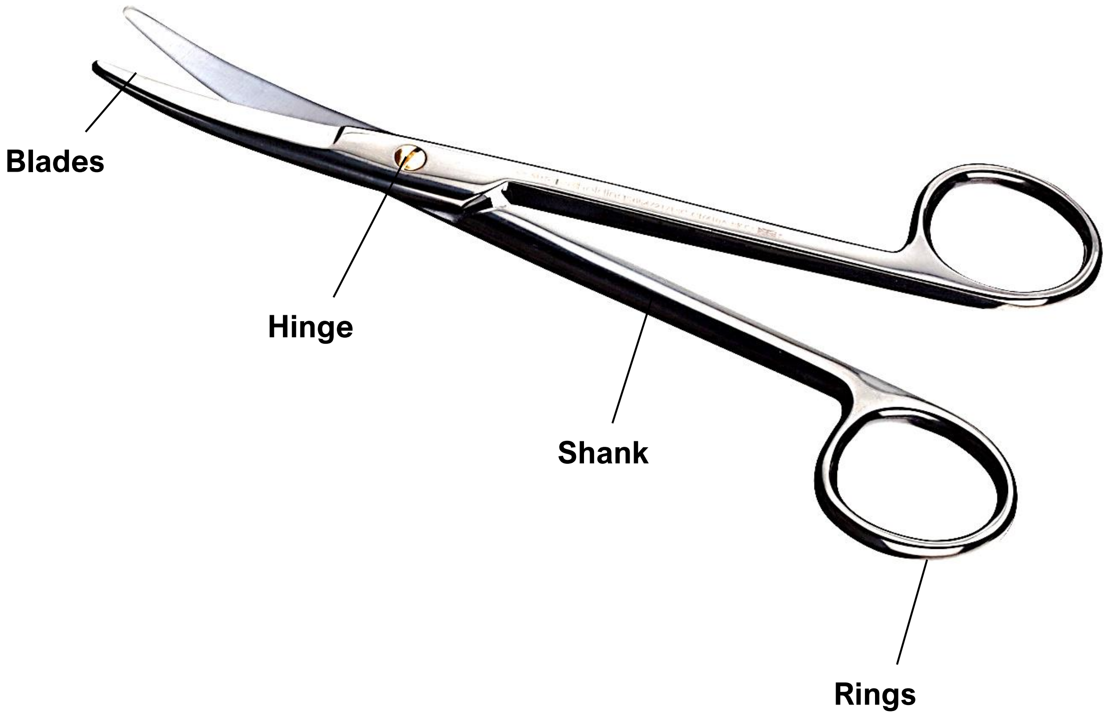
BP Handle types

Technique of holding the scalpel

The scalpel should be held by the pencil grip, which involves holding the scalpel handle between the thumb and the index finger, as one one would hold a pencil. The pemcil grip allows maximum control over the cut but reduces the contact surface between the blade and the tissues because of the angle created.

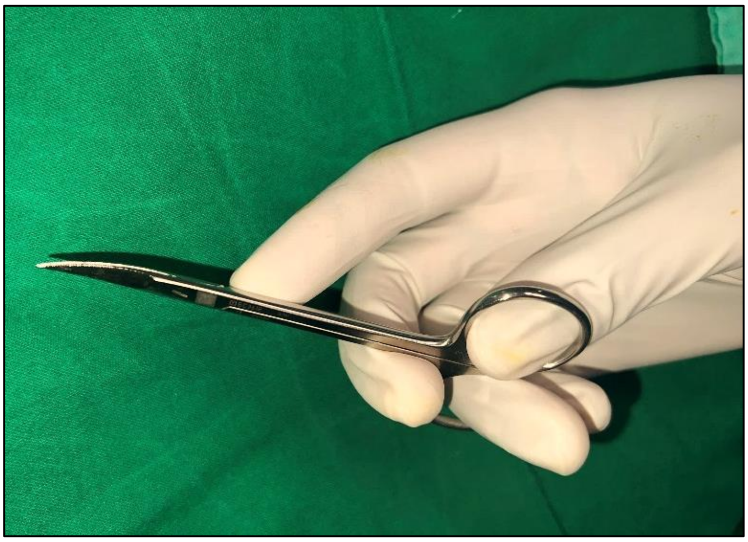


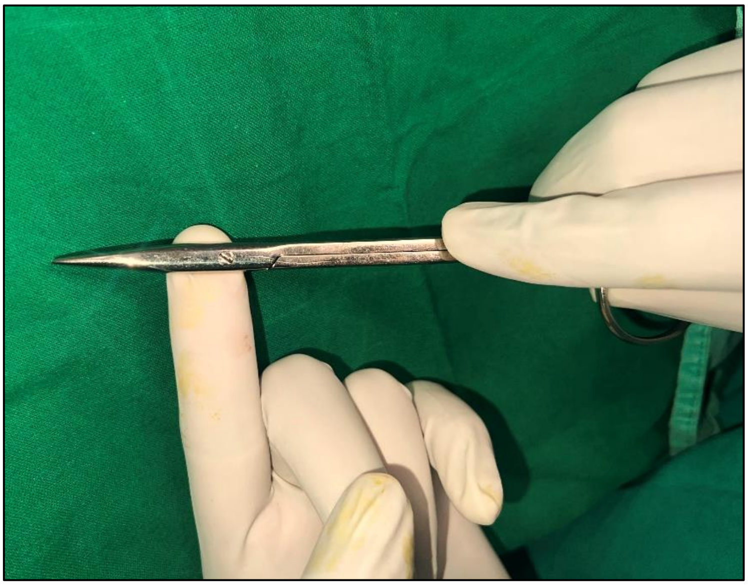
Scissors



Technique of holding the scissors

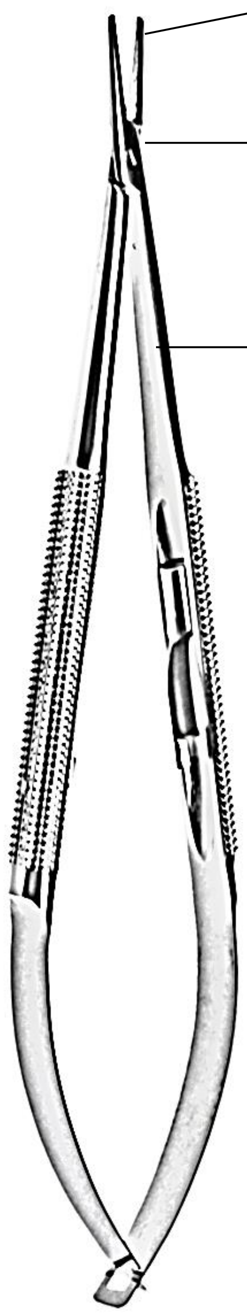
Scissors are held similar to needle holders with the ring finger in one loop, the thumb in the other, and the index finger resting near the hinge to provide optimal stability and control of the instrument.



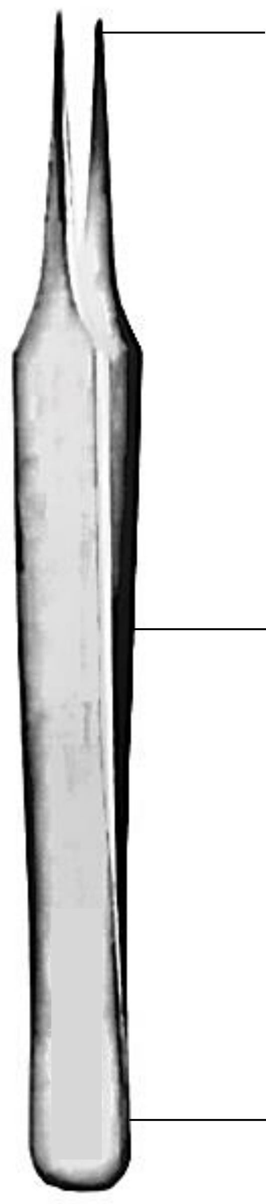


Micro instruments

Micro needle holder



Micro forceps



Placement of a suture

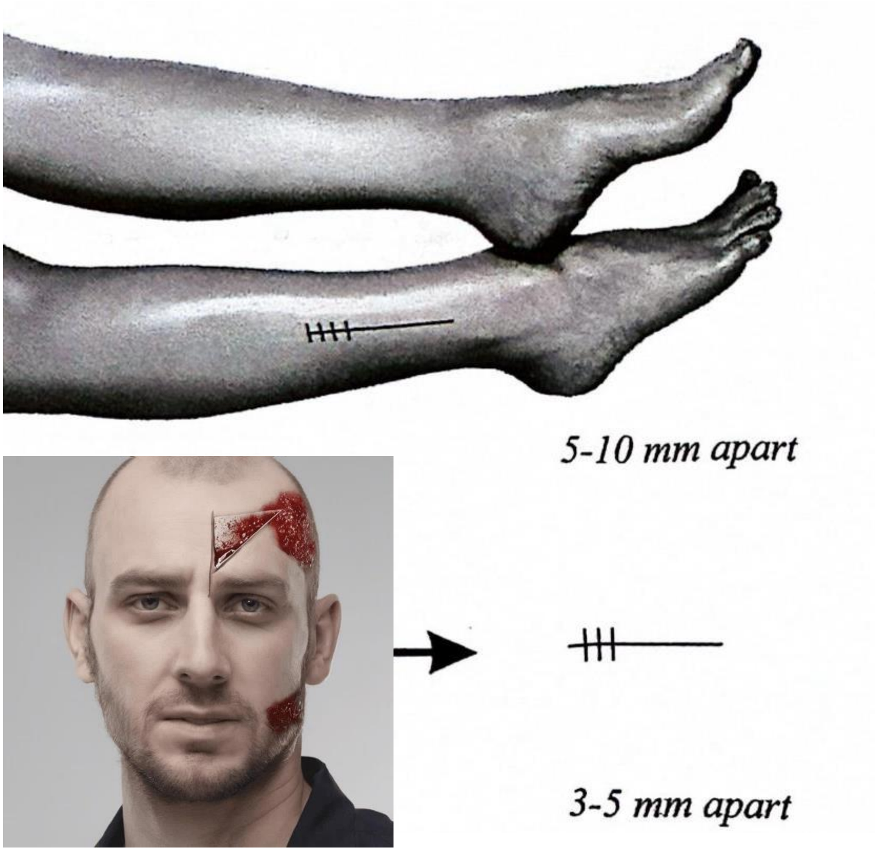
Placing the sutures

Bites should be about 4-5mm from wound edges.

Sutures should be spaced about 5 to 7 mm apart, enough to approximate the wound edges but not so tight to cause ischemic skin edges.

For most areas of the body, except the face, the sutures should be placed in the skin 3-4mm from the wound edges and 5-10mm apart.

Sutures placed on the face should be approximately 2-3mm from the skin edge and 3-5mm apart. Sutures placed elsewhere on the body should be approximately 3-4mm from the skin edge and 5-10mm apart.



The Science of Putting a Knot

A basic knot has several key components:

1. The limbs of the suture
   Once the needle goes through both sides of the skin, there are two limbs of the suture on either side. The needle end is kept long, and this is known as the long limb. The angle created between the limbs is termed as the 'angle of victory' or the 'V triangle'. As a rule, the length of the short limb is determined by the amount of suture material that is adequate to put the knot. On the other hand, the long limb which is held by hand is approximately three times the length of the short limb. Once the Surgeon positions to complete the knot, the long limb is held with the finger or forceps, and the needle holder is placed inside the V triangle followed by the long limb being twisted two times and the short limb is grabbed by its jaws. At this point the first throw of the Surgeon's knot is complete, and the limbs are pulled apart and the first part of the knot is placed on the most suitable site of the incision.

2. Where to place the knot
   Placing the knot on the correct side of the incision is decided by the Surgeon depending on few factors:
   a) The most convenient side of the skin to place knots i.e. where the knot wants to sit.
   b) Where the side of the skin incision appears to be higher, therefore placing the knot will flatten the elevated side to reach the level of incision.
   c) To avoid ragged or potentially colonized site of incision, the knot can be placed on the uninjured side if the skin.
   d) Placing the knot away from a vital structure, e.g. eye, lip, nose, ear; to avoid the suture ends going inside these structures.

Once the second throw is done, the knot becomes stabilized. The surgeon needs to evaluate the quality of the knot after this throw. There should not be any gaps between the wound edges, there should not be space between two throws. Squaring of the knot means that the knot will not slip.

Suture size
A suture size of 5/0 or 6/0 is used on the face.
A suture size of 4/0 or sometimes 3/0 (if more strength is required) is used on the trunk or extremity.

Procedure
Start on the side of wound, opposite and farthest from you to ensure that you are always sewing toward yourself. By sewing toward yourself, the suturing process is made easier from a biomechanical standpoint.

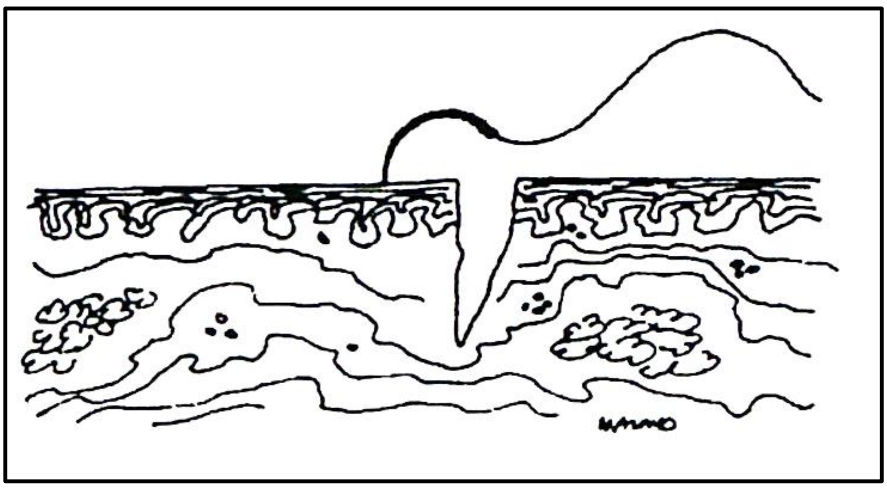
Simple interrupted sutures

Indications: This technique is the easiest to perform. It is used for most skin suturing.

Technique

1. Start from the outside of the skin, go through the epidermis into the dermis from one side, then enter the dermis from on the opposite side, and come out the epidermis above.
2. To ever the edges, the needle tip should enter at a 90^{o} angle to the skin. Then turn your wrist to get the needle through the tissues.
3. You can use simple sutures for a continuous or interrupted closure.

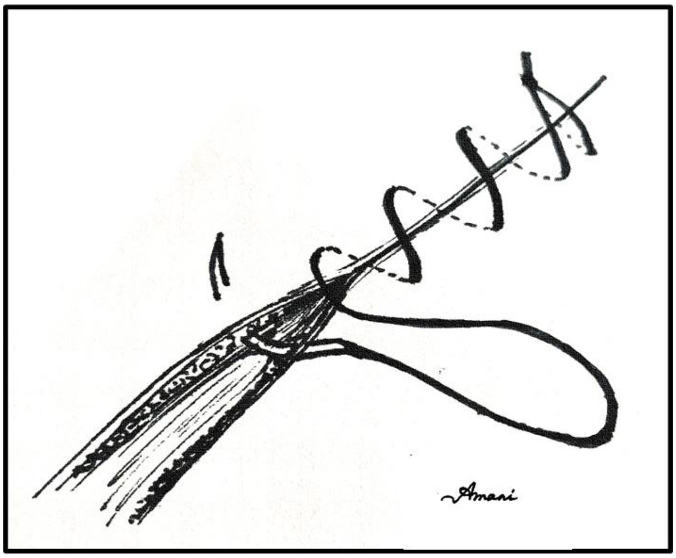
Tips for better technique: Grip swaged needles by the body and not by the swage to avoid needle damage. Depth of the bite should be equal on both sides for proper alignment.



Other suturing techniques

Running suture

The "Running" stitch is made with one continuous length of suture material. Used to close tissue layers which require close approximation, such as the peritoneum. Also used in skin or blood vessels. The advantages of the running stitch over the interrupted stitch are speed of execution, and accommodation of edema during the wound edges.



Interrupted suture

Each stitch is tied separately. Used in skin or underlying tissue layers.

<u>Advantages over running stitch</u>

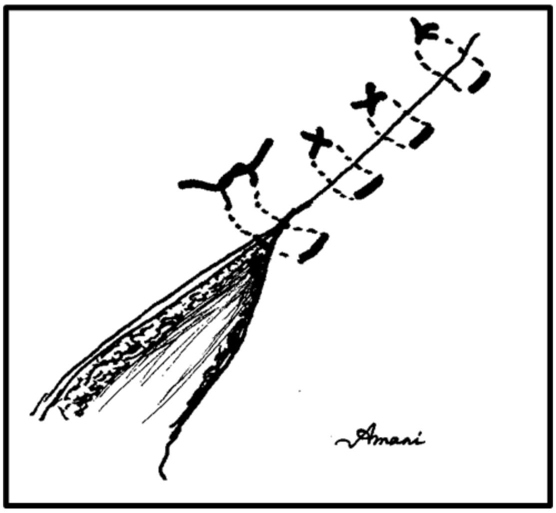
- Good approximation of wound edges
- Greater tensile strength
- Less potential for wound edema and impaired circulation.

<u>Disadvantages</u>

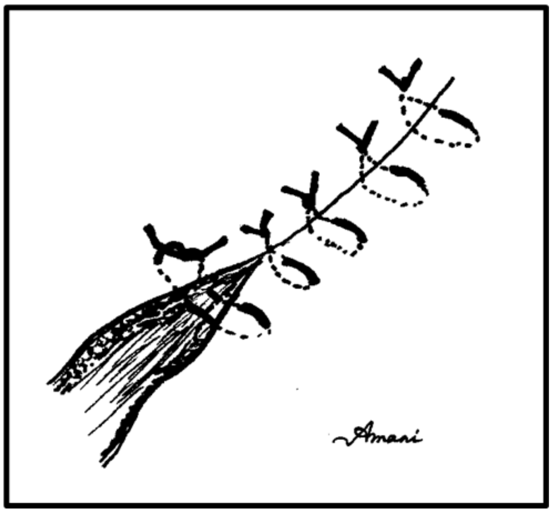
- More time intensive
- Increased risk of cross hatch marks at suture line.

Mattress suture

A double stitch that is made parallel (horizontal mattress) or perpendicular (vertical mattress) to the wound edge. The chief advantage of this technique is strength of closure; each stitch penetrates each side of the wound twice and is inserted deep into the tissue.



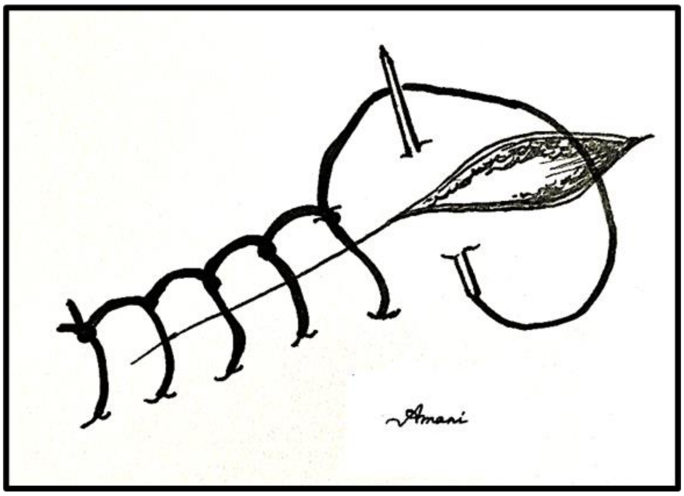
Horizontal Mattress Suture



Vertical Mattress Suture

Continuous locking blanket suture

A self – locking running stitch used primarily for approximating skin edges.



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