Sutures and knot tying
Goals of wound closure

- Elimination of dead space
- Approximation of wounds to maintain tensile strength until the skin can heal.
- Minimizing bleeding and infection.
- Aesthetic repair of surgical wound.
- Reconstruction or restoration of physiologic domain.
Suture material qualities

- Sterile
- Functionality; ability to be used in various parts of the body.
- Causes minimal tissue injury or tissue reaction (ie, nonelectrolytic, noncapillary, nonallergenic, noncarcinogenic)
- Easy to handle
- Holds securely when knotted (no fraying or cutting)
- High tensile strength
- Favorable absorption profile
- Resistant to infection
Suture material types

- Natural sutures: made from animal intestines (catgut) or collagen derivatives.
- Monofilament: single stranded, passes with less resistance in the tissue, should be handled with care as kinks in the strand can cause breakage.
- Braided: more trauma with passage through tissues. However, more pliable and ties down more securely. However, suture material has increased capillarity and are prone to infection.
Suture material types

- Absorbable sutures provide temporary wound support, until the wound heals well enough to withstand normal stress.
- Absorption occurs by enzymatic degradation in natural materials and by hydrolysis in synthetic materials.
Suture material types

- Nonabsorbable sutures elicit a tissue reaction that results in encapsulation of the suture material by fibroblasts.
- Class I – Silk or synthetic fibers of monofilament, twisted, or braided construction
- Class II – Cotton or linen fibers or coated natural or synthetic fibers in which the coating contributes to suture thickness without adding strength
- Class III – Metal wire of monofilament or multifilament construction
Absorbable sutures

- Natural
  - Collagen (gut): derived from submucosa of intestine is treated with an aldehyde solution, which cross-links and strengthens the suture and makes it more resistant to enzymatic degradation. Strength is maintained for 7–10 days and absorption is complete within 70 days.

- Chromic gut (treated with chromium salt): Tensile strength is maintained for 10–14 days. The absorption rate is slowed by chromium salt, 90 days for complete absorption.
Absorbable suture

- Synthetic
- Chemical polymers are absorbed by hydrolysis and cause a lesser degree of tissue reaction following placement.
- Polyglactin 910 (Vicryl): This synthetic suture is a braided multifilament suture coated with a copolymer of lactide and glycolide (polyglactin 370).
- Tensile strength is approximately 65% at 14 days postimplantation. Absorption is minimal for 40 days and complete in 56–70 days. These sutures cause only minimal tissue reaction.
- Vicryl sutures are used in general soft tissue approximation and vessel ligation.
Poliglecaprone 25 (Monocryl): This synthetic suture is a monofilament suture that is a copolymer of glycolide and e-caprolactone. The suture has superior pliability, leading to ease in handling and tying. Tensile strength is high initially, 50–60% at 7 days, and is lost at 21 days. Absorption is complete at 91–119 days. Poliglecaprone sutures are used for subcuticular closure and soft tissue approximations and ligations.
Polydioxanone (PDS II): This is a polyester monofilament suture made of polydioxanone. This suture provides extended wound support and elicits only a slight tissue reaction. Tensile strength is 70% at 14 days and 25% at 42 days.

Wound support remains for up to 6 weeks. Absorption is minimal for the first 90 days and essentially complete within 6 months. This material has a low affinity for microorganisms (like other monofilament).
Absorbable suture

- PDS II suture is used for soft tissue approximation, especially in pediatric, cardiovascular, gynecologic, ophthalmic, plastic, and digestive (colonic) situations. Another similar suture material is made from polytrimethylene carbonate (Maxon). This material has a similar tensile strength and absorption profile.
Nonabsorbable suture

- Natural
- Surgical silk: This suture is made of raw silk spun by silkworms. The suture may be coated with beeswax or silicone.
- Many surgeons consider silk suture the standard of performance (superior handling characteristics).
- Although classified as a nonabsorbable material, silk suture becomes absorbed by proteolysis and is often undetectable in the wound site by 2 years. Tensile strength decreases with moisture absorption and is lost by 1 year.
- The problem with silk suture is the acute inflammatory reaction triggered by this material. Host reaction leads to encapsulation by fibrous connective tissue.
Nonabsorbable sutures

- Synthetic
- Nylon: This is a polyamide polymer suture material available in monofilament (Ethilon/Monosof) and braided (Nurolon/Surgilon) forms.
- The elasticity of this material makes it useful in retention and skin closure.
- Nylon suture has good handling characteristics, although its memory tends to return the material to its original straight form.
- Nylon has 81% tensile strength at 1 year, 72% at 2 years, and 66% at 11 years. The material is stronger than silk suture and elicits minimal acute inflammatory reaction.
Polypropylene (Prolene): This monofilament suture is an isostatic crystalline stereoisomer of a linear propylene polymer. The material does not adhere to tissues and is useful as a pull–out suture (eg, subcuticular closure).

This material is biologically inert and elicits minimal tissue reaction. Prolene is not subject to degradation or weakening and maintains tensile strength for up to 2 years.
Nonabsorbable suture

- This material is useful in contaminated and infected wounds, minimizing later sinus formation and suture extrusion.
Surgical needle

Diagram:
- Tip
- Body
- Swage
- Suture Material
Surgical needle

- Taper needles are the most widely used needles for general tissues.
- Cutting needles are used primarily for closure of the skin. In a reverse cutting needle, the cutting edge is on the greater curve.
A needle holder is used to grasp the needle at the distal portion of the body, one half to three quarters of the distance from the tip of the needle. The needle is held vertically and longitudinally perpendicular to the needle holder.
Suture placement
Suture placement

- The needle holder is held by placing the thumb and the fourth finger into the loops and by placing the index finger on the fulcrum of the needle holder to provide stability. Holding the needle holder in the palm can improve dexterity.
Suture placement

- The needle should always penetrate the skin at a 90° angle, which minimizes the size of the entry wound and promotes eversion of the skin edges.
- The 2 sides of the suture should become mirror images, and the needle should also exit the skin perpendicular to the skin surface.
Suture placement
Suture placement
Knot tying

- The instrument tie is used most commonly in cutaneous surgery. The square knot is traditionally used. First, the tip of the needle holder is rotated clockwise around the long end of the suture material for 2 complete turns.
The tip of the needle holder is used to grasp the short end of the suture. The short end of the suture is pulled through the loops of the long end by crossing the hands, such that the 2 ends of the suture material are situated on opposite sides of the suture line.
Knot tying

- The needle holder is rotated counterclockwise once around the long end of the suture. The short end is grasped with the needle holder tip, and the short end is pulled through the loop again.
Knot tying
Simple interrupted suture
Horizontal mattress suture
Vertical mattress suture
Vertical mattress suture

- Eliminates dead space, everts the skin edge. This stitch causes crossmarks. This can be avoided with early removal of sutures.
Buried sutures

- The suture is placed by inserting the needle parallel to the epidermis at the junction of the dermis and the subcutis.
- The needle curves upward and exits in the papillary dermis, again parallel to the epidermis.
The needle is inserted parallel to the epidermis in the papillary dermis on the opposing edge of the wound, curves down through the reticular dermis, and exits at the base of the wound at the interface between the dermis and the subcutis and parallel to the epidermis.
Subcuticular stitch

- The running subcuticular suture is a buried form of the running horizontal mattress suture. It is placed by taking horizontal bites through the papillary dermis on alternating sides of the wound. No suture marks are visible, and the suture may be left in place for several weeks.
The subcuticular stitch gives the best possible cosmetic result is desired. Because the epidermis is penetrated only at the beginning and end of the suture line, the subcuticular suture effectively eliminates the risk of crosshatching.
Subcuticular stitch

- The suture does not provide significant wound strength, although it does precisely approximate the wound edges. Therefore, the running subcuticular suture is best reserved for wounds in which the tension has been eliminated with deep sutures, and the wound edges are of approximately equal thicknesses.
Subcuticular stitch
Suture removal

- Sutures should be removed within 1–2 weeks of their placement, depending on the anatomic location.
- Timely removal reduces the risk of suture marks, infection, and tissue reaction.
- The average wound usually achieves approximately 8% of its expected tensile strength 1–2 weeks after surgery.
The greater the tension across a wound, the longer the sutures should remain in place.

On the face, sutures should be removed in 5–7 days; on the neck, 7 days; on the scalp, 10 days; on the trunk and upper extremities, 10–14 days; and on the lower extremities, 14–21 days.