Sutures

Sutures are materials (silk thread, wire, synthetic material, etc.) with which two surfaces are kept in apposition.

Properties of sutures

- *Tensile strength* is the measured level of tension that a knotted suture strand can withstand before breaking. Generally speaking, the larger the size of the strand, the higher the tensile strength.
- *Size* denotes the diameter of the material. The measurement has been standarddized, the more zeroes (0's) in the number, the smaller the size of the strand. As the number of 0's decreases, the size of the strand increases. Thus a 5-0 sutures means 00000 is smaller than a size 4- 0 (which means 0000).
- *Memory* pertains to the suture's tendency to return back to its resting or previous shape; a high memory leads to poor knot holding. In general, monofilament sutures have higher memories than multifilament sutures.
- *Hand* relates to the feel of the suture in the surgeon's hand, the smoothness with which it glides through the tissue and how well it ties down. It's a very subtle property.
- *Extensibility* relates to the way a suture will stretch slightly during knot tying and then recover. This stretching alerts the surgeon to the precise moment when the knot is secure.

An ideal suture should elicit no tissue reaction, handle perfectly, tie securely, does not encourage infection and has no capillary action. No suture satisfies all these criteria.

Suture Classification

1. Absorbable vs Nonabsorbable
2. Monofilament vs Multifilament
3. Natural vs Synthetic

Absorbable:

Absorbable sutures are capable of being absorbed by mammalian tissue. Two major mechanisms of absorption result in the degradation of absorbable sutures. Sutures of biological origin (i.e. Natural) such as catgut are gradually digested by tissue enzymes. Sutures manufactured from synthetic polymers are principally broken down by hydrolysis in tissue fluids.

Catgut: this is obtain from the submucosa of the sheep. When it is untreated, it is called *plain catgut* and it has an absorption time of 7-10 days. When treated with chromium salt, it is called *chromic catgut* and the absorption time lengthened to 20 days. Because it is foreign protein, it elicits severe reaction which may interfere with wound healing. Plain catgut evokes a more severe inflammatory reaction than chromic catgut. Plain catgut may be used for suturing fast healing tissues and where presence of foreign bodies may evoke unpleasant reactions eg the bladder. Chromic catguts are used for muscles, some fascia, gut etc.

Polyglycolic Acid (Dexon) is an absorbable, braided, synthetic suture material which has a higher tensile strength than catgut. Total reabsorption by hydrolysis during

wound healing occurs at 60 to 90 days postoperatively. Other examples are *Polyglyconate* (Maxon), *Polyglactic acid* (Vicyl) and *Polydiaxonone* (PDS)

NonAbsorbable:

Nonabsorbable sutures are made from a variety of non-biodegradable materials and are ultimately encapsulated or walled off by the body's fibroblasts. Non-absorbable sutures ordinarily remain where they are buried within the tissues. When used for skin closure, they must be removed postoperatively.

Silk is a protein filament obtained from the silkworm larva. It is a multifilament suture. The suture has good tensile strength, is easy to handle, and has excellent knot characteristics. Because of its excellent knotting characteristics, it is used where secure knotting is desirable, for example, ligature of major vessels after amputation.

Nylon is a synthetic polyamide polymer which is available in both monofilament and multifilament forms. It is very strong and smooth, but extra care must be taken in tying to prevent knot slippage. Its smooth, monofilament composition ensures easy passage through tissue and minimal reaction. Nylon sutures are the most commonly used sutures for the skin.

Stainless steel wire, made from low-carbon iron alloy, can be monofilament or multifilament. Wire is the strongest and least reactive suture. However, its handling characteristics are very poor, and great care must be taken to prevent kinking and cutting through tissue. Wire is used mainly in ligament, tendon, and bone operations. *Cotton and polypropylene (Prolene)* are other types of non-absorbable sutures.

Monofilament

This suture is made of a single strand. It resists harboring microorganisms, and it ties down smoothly. Monofilament sutures generally have poorer handling and knotting characteristics than multifilament sutures.

Multifilament

A *multifilament* suture consists of several filaments twisted or braided together. This gives good handling and tying qualities. However, it can harbour microorganism between its strands and by capillary action encourage transfer of microorganism from one part of the wound to the other. They should therefore be avoided where the wound is contaminated.

Surgical needles

Surgical needles are necessary for the placement of sutures in tissues; the ideal needle should carry suture material through tissue with minimal trauma. They should be sharp enough to penetrate tissue with minimal resistance. They should be rigid enough to resist bending, yet flexible enough to bend before breaking. They must be sterile and corrosion-resistant to prevent introduction of microorganisms or foreign bodies into the wound.

All surgical needles have three basic components: the *attachment end*, the *body*, and the *point*.
Attachment end or the eye: These may be may be open, closed, or swaged. The open or closed types have the disadvantage of additional bulk and thus renders additional trauma to the tissue; because of this, majority of sutures used today have appropriate needles attached by the manufacturer. *Swaged* sutures join the needle and suture together as a continuous unit that is convenient to use and minimizes tissue trauma.
The body: This is the part of the needle which is grasped by the needle-holder during the surgical procedure. It should be as close as possible to the diameter of the suture material. The curvature of the body may be straight or curved. The cross-sectional configuration of the body may be round, oval or triangular.
The point: This extends from the extreme tip of the needle to the maximum cross-section of the body. The basic needle points are cutting, tapered, or blunt. The cutting point is used to cut through tough tissues, such as skin. The tapered point is used on soft, vulnerable tissue while blunt point is used for friable tissue.

Principles of Suture Selection

The surgeon has a choice of suture materials from which to select for use in body tissues. Adequate strength of the suture material will prevent suture breakage. Secure knots will prevent knot slippage. But the surgeon must understand the nature of the suture material, the biologic forces in the healing wound, and the interaction of the suture and the tissues. The following principles should guide the surgeon in suture selection.

1. When a wound has reached maximal strength, sutures are no longer needed. Therefore:
a. Tissues that ordinarily heal slowly such as skin, fascia, and tendons should usually be closed with nonabsorbable sutures. An absorbable suture with extended (up to 6 months) wound support may also be used.
b. Tissues that heal rapidly such as stomach, colon, and bladder may be closed with absorbable sutures.

2. Foreign bodies in potentially contaminated tissues may convert contamination to infection. Therefore:
a. Avoid multifilament sutures which may convert a contaminated wound into an infected one.
b. Use monofilament or absorbable sutures in potentially contaminated tissues.

3. Where cosmetic results are important, close and prolonged apposition of wounds and avoidance of irritants will produce the best result. Therefore:
a. Use the smallest inert monofilament suture materials such as nylon or polypropylene.
b. Avoid skin sutures and close subcuticularly, whenever possible.
c. Under certain circumstances, to secure close apposition of skin edges, a topical skin adhesive or skin closure tape may be used.

4. Foreign bodies in the presence of fluids containing high concentrations of crystalloids may act as a nidus for precipitation and stone formation. Therefore:
a. In the urinary and biliary tract, use rapidly absorbed sutures.

5. Regarding suture size:
a. Use the finest size, commensurate with the natural strength of the tissue.
b. If the postoperative course of the patient may produce sudden strains on the suture line, reinforce it with retention sutures. Remove them as soon as the patient's condition is stabilized.

Alternatives to Sutures

- Staples
- Skin tapes
- Surgical adhesives

Surgical Drains

Surgical drains are devices, usually in the shape of a tube or wick, for removing fluid as it collects in a cavity, especially a wound cavity.

Material Composition

Latex rubber: These are soft, pliable but excite a lot of tissue reactions and thus should not be used in infected wounds.
PVC: Much less reactive than latex rubber but is less pliant and tends to harden and split with prolonged use.
Silicon: The least reactive and most pliant; the most ideal of the three.

Drainage systems

Open (static) drainage
The drain is exteriorized either through the operation wound or via a separate stab wound. It is stitched to the skin or held in place by a safety pin and covered with a gauze pad. Incidence of wound infection is higher in this type of drainage than in any other. Examples are Penrose drains and corrugated drains.
Closed siphon drainage
Tube drains are connected to a drainage bag equipped with a one-way valve at the entrance to the bag and a drainage tap at the opposite end. This allows emptying without opening the connection between the bag and the drain. This helps to reduce the incidence of wound contamination.
Closed suction drainage
The drains are connected to portable suction devices. These suction devices utilize low pressure devices. Examples are Redivac® and Portovac®. They consist of bottles from which the air has been sucked to create a vacuum.
Sump suction drainage
These rely on a continuous flow of air from outside the sump to work. Sump drains have double or triple lumens that allow irrigation and aspiration. Pressure in the

catheter is maintained at atmospheric levels, and tissue occlusion of the drain is less likely. The sump drain is most useful in managing enteric fistulas with high volumes.

Underwater seal drainage

This is used for draining the pleural space. The end of the drain is immersed in water to prevent air from being sucked into the pleural space.

Indications for drain insertion

(1) Conditions in which the use of drain is a life-saving measure.

Tension pneumothorax

Massive haemothorax.

(2) Conditions in which drainage is of proven therapeutic importance or constitutes a safe prophylactic measure.

Chest drainage

Post thoracotomy

Abscesses and Cysts

After extensive skin flaps

Contraindications to insertion of drains

(1) Peritonitis due to perforation of a hollow viscus
(2) Acute pancreatitis
(3) After excision of malignant tumours

Complications of drains

(1) Infections
(2) Impaired healing
(3) Pressure necrosis of adjacent organs especially edematous hollow viscus
(4) Extrusion
(5) Migration
(6) Intrusion
(7) Retained i.e. part of it may severed and be retained inside
(8) Blockage.

Removal

Drains should be removed once the indication for their insertion has been treated.

Catheters

A catheter is a flexible tube inserted into some part of the body that provides a channel for fluid passage or a medical device. The word "catheter" comes from the Greek word for "let down" Most commonly, they are used to drain fluids. Urinary catheterization is the most common indication. Catheters are also used to deliver devices and drugs via vessels and hollow organs internally.

Indications

This can be diagnostic or therapeutic.

Diagnostic

(1) Measurement of body statistics e.g. Central Venous catheters, Swantz Ganz catheters, compartmental pressure.
(2) Taking specimen cytological examination
(3) Taking specimen microbiological examination e.g. catheter specimen of urine
(4) Monitoring patient's response to treatment e.g. catheterization in burns or shock patients
(5) To deliver radio-opaque dyes for venography or arteriography

Therapeutic

(1) To drain body cavities e.g. bladder, stomach, ventricle (hydrocephalus) etc.
(2) To deliver drugs to specific locations e.g. Intra-arterial cytotoxic drugs, or
(3) Post operative drains
(4) For feeding e.g. NG Tubes, parenteral nutrition
(5) In interventional radiology: To control internal haemorrhage by delivering at the site of the bleeding
(6) As temporary arterial shunts

Complications

(1) Infections
(2) Blockage
(3) Migration
(4) Ejection
(5) Catheter tip breakage
(6) Thrombosis