

SURGICAL SUTURE

Types, indications and features

OVERVIWE

The surgical suture is a medical device used in closing wound edges or repairing tissue damage, there are many types of sutures with different specification suitable for wide variety uses. Sutures are classified according to many characteristics such as:

- ❖ All surgical sutures are either, absorbable sutures which decomposed in the body and doesn't need to be removed by doctor, or non-absorbable sutures which need to be removed from surgeon after wound healing. (these is the basic classification).
- ❖ It's classified according to structure of material either monofilament suture composed of a single fiber, or multifilament (braided) composed of many small fibers braided together
- ❖ According to origin of suture material, either natural like silk, cotton or catgut which made from sheep intestines, or synthetic; like poly Glycolide, poly lactic acid, nylon, poly ester
- ❖ And several another classification like coated or not coated, dyed or undyed.

The ideal suture material should have several basic characteristics to be high in quality and for minimal risk as following:

- the composition of suture material can be used in many surgical procedures.
- Without any foreign-body left inside body, irritants that caused tissue reaction.

- Surgical suture should be non-antigenic and non-pyrogenic.
- Should be non-electrolytic
- Sterile by any sterilization method such as sterilization by ethylene oxide or by gamma radiation. as the sterilization method are critical to minimize a infection of wound.
- it should have a high tensile strength according to material size and material structure.
- it's easy to handle.
- uniform size according to suture diameter.
- causes minimal tissue trauma.
- the chemical composition should not cause toxicity in body after degradation.
- It holds securely when knotted

New technologies are available, like laser technology or medical glue equipment that are used for wound closure which make the process quicker and reduce scar.

Basic Suture Characteristics

1- Absorbable or non-absorbable:

Absorbable suture:

It's a suture which made from material broken down harmlessly in tissue after a period of time (7 days to 8 weeks) according to absorbable suture chemical components, by two mechanisms:

- a) enzymatic break down for suture derived from biologic origin (natural material). For example, chromic gut is digested by intraoral enzyme or when



PH is low so it's not suitable for oral implant procedure, usually those sutures lose their tensile strength so fast (often in days).

- b) degradation in body by hydrolysis process for synthetic material, which causes tissue reaction less than enzymatic degradation. the hydrolysis process is an organic chemical reaction by using water to break a part of molecules, the basic feature of absorbable suture is the sensitivity to moisture which reduces from tensile strength, then degradation in body such as poly glycolic acid.

Absorption time: is the period for losing 45-65% of knot's tensile strength according to suture material, absorbable sutures often used in internal tissue, to approximate tissue during healing process. during these times the suture loses its tensile strength to be decomposed at the end, For example polyglactine.

Non-absorbable suture:

It's a suture which is made of material remains in the body without any change. it needs to be manually removed by doctor after healing. When it is placed in the body tissue the non-absorbable suture elicits tissue reaction which result in encapsulated with wound scar by fibroblast. this type is used to provide more approximate to tissue and commonly used in soft tissues in general including cardiovascular, neurological procedures and skin closure. Non-absorbable suture includes for example silk, poly propylene, poly amid, and polyester

2-monofilament or multifilament:

The different only with structure for each type which cause different with some properties and characteristics.



Monofilament suture:

Monofilament suture is made from single strand of material, this structure relatively more resistance to harboring microorganisms and it has less resistance to passage through tissue, thus causes less tissue trauma and wound injury. But the careful should be taken in handling and tying because suture crushing can lead to weaken and undesirable suture failure.

Multifilament suture:

This type made from several strand twisted or braided together to compose final form, multifilament suture in general has more tensile strength than monofilament suture and easier handling and tying and has more flexibility.

3-natural or synthetic suture:

Natural:

All sutures made of biological sources are natural. plant sources of natural suture are Cotton or silk and animal source like catgut, these materials can cause Tissue reaction and lead to inflammatory reactions.

Synthetic:

Suture which is made from wide range of artificial polymers causes minimal tissue reaction. Like poly glycolic acid, poly amid, Poliglecaprone 25



Surgical suture materials

1-absorbable suture materials:

1-1-poly glycolic acid (Dexon):

Absorbable synthetic braided multifilament sutures made from poly ester polymerized from hydroxyacetic acid. PGA suture is coated with polycaprolactone and calcium stearate to improve handling properties. Poly glycolic suture is absorbed in vivo by hydrolysis mechanism and rapidly loses tensile strength, all materials which are result from absorption process don't assist bacterial growth, and its reaction with the tissue is considered less than catgut reaction. Poly glycolic is used for general soft tissues closure which includes several procedures such as ophthalmic surgery except neurology, and cardiovascular surgery. these sutures unsuitable for the use in oral cavity or in area which contain infected urine because the alkaline pH increases breaking down period. Also, it shouldn't be used where extended approximation or ligation of tissue is required.

2-1-polyglactin 910 (Vicryl):

Absorbable synthetic braided multifilament sutures made from co-polymer composed from 90% glycolide and 10% L-lactide, lactide which gives hydrophobic properties more than poly glycolic acid, that reduces water molecular ingress into polymer, therefore polyglactin have greater initial tensile strength than PGA.

This suture is coated so it elicits minimal inflammatory reaction and it's absorbed in vivo by hydrolysis mechanism similar to PGA absorption mechanism, completed absorption after 90 occur without any residuals of polymer. PGLA sutures are used



in most open surgeries, contaminated wounds, abdominal surgery and laparoscopic, but shouldn't be used in cardiovascular surgery, neurosurgery or extended approximation or ligation soft tissue.

3-1-Polyglactin 910 Rapid (vicryl rapid):

Absorbable synthetic braided multifilament sutures have almost 66% of initial tensile strength of DAMACRYL 910, and it loses tensile strength faster than PGLA and is more rapidly absorbed in vivo. These suture designed to perform the role of catgut but without any inflammatory reaction in the tissue, where long-term support is not required such as the urinary surgery.

4-1-Poliglecapron 25 (Monocryl):

Absorbable synthetic monofilament sutures, made from copolymer 75:25 poly (glycolide-co-caprolactone), poliglecapron sutures have following features which making it good option:

- Good flexibility and Ideal memory, easy to bend, stretch and easy handling.
- Have high softness and smoothness, gliding and easy to passage through tissue with minimal tissue trauma.
- Knot security and adequate knot tying properties causes minimal tissue reaction.
- Initial tensile strength is greater than the tensile strength for catgut or equal to it but without tissue reaction

Poliglecaprone 25 recommended in approximation and ligation of general soft tissues, bladder surgery and subcutaneous closure.



5-1-Polydioxanone (PDS):

Absorbable synthetic monofilament sutures made from poly (P-dioxanone). Absorbed in vivo by hydrolysis mechanism but its initial is greater than tensile strength of poly glycolic acid, catgut and polyglactin 910. where its advantages are retention of tensile strength after plantation, easy passage through tissue with minimal tissue trauma due to its smoothness and high flexibility. PDS has disadvantage as it has the poorest knot security of synthetic absorbable sutures. It's recommended to use where the prolonged approximation and extended support of tissue is required for period up to 6 weeks and it's completely absorbed in 240 days.

6-1-Catgut:

Absorbable natural sutures which have two forms (plain or chromic), these sutures are composed of purified connective tissue (mostly collagen), and are derived from natural sources such as serosal layer of beef, or submucosal fibrous layer of sheep intestine. Surgical gut is broken down by enzymatic degradation in body and causes an inflammatory reaction in soft tissue. Catgut sutures are treated with salt chrome solution to reduce inflammatory reaction with the tissue during the passage through it, this provides more absorption time. While plain gut is absorbed rapidly in vivo. Quality of catgut is determined according to collagen percentage, higher collagen percent mean higher tensile strength, lower tissue reaction in vivo, longer absorption time in vivo. Cut gut is used in all surgical procedures such as ophthalmic, orthopedics, Subcutaneous and in rapid healing tissue.



2-non-absorbable suture materials:

1-2-Silk sutures :

Non-absorbable natural braided multifilament sutures derived from cocoon silkworm, it is coated with wax or silicon to improve passage through tissue, reduce tissue friction and reduce capillarity, where silk elicits tissue inflammatory reaction and has intense capillarity.

Silk sutures have poor knot security, its initial tensile strength is more than catgut but it loses portion of tensile strength after one year and completely absorption may occur after 2 years. Silk advantage is easy handling and is consider benchmark for handling properties. Silk sutures are used in mucosal and ophthalmic surgery and shouldn't be used when prolonged tissue approximation is required. prolonged contact with salt solution may cause calculi occur in urine track.

2-2-Polyamide (Nylon 6):

Non-absorbable synthetic suture composed from long chain of polymer of nylon 6 it's commonly in monofilament form, also multifilament form is available.

Polyamide monofilament sutures have ideal memory (memory is the ability of a suture material to return to previous shape after deformation) but without good knot security, so it tends to have slippage knot where it needs 4 or 5 throws to place a knot. multifilament nylon has low memory and high infection rate. nylon sutures have excellent tensile strength and after 2 years nylon loses 30% of initial tensile strength. Nylon sutures is considered so ideal for skin and surface closure



such as epidermal superficial, finer sizes used in ophthalmic surgery and microsurgery procedures.

3-2Polypropylene (Prolene):

Non-absorbable synthetic monofilament sutures, is the first suture developed as synthetic non-absorbable suture, made of isotactic crystalline stereoisomer of polypropylene, has high smoothness and easy passage through tissue but poor knot security and need 5 throws to make secure knot. It has high tensile strength and greatest one for all synthetic non-absorbable suture without any reduce of tensile strength after implantation. polypropylene is high elastic suture and has high memory which is one of the few disadvantages to poly propylene. This suture can be used as intradermal suture, and indicated for use in general soft tissue approximation and ligation, including use in cardio vascular, ophthalmic, plastic, neurological procedures and also used in micro surgery.

4-2-Polyester (Ethipond):

Non-absorbable synthetic multifilament braided sutures, made of poly ethylene terephthalate. Elicits high tissue reaction and greater than any non-absorbable synthetic sutures, polyester sutures are stronger than silk and have permanent tensile strength but without good knot security and it's recommended to knot 5 square knots to guarantee knot security. Polyester sutures due to its unique properties is used in permanent and removable fixtures such as implantation prostheses in order to everlasting retention of tensile strength, it's considered excellent choice for cardiovascular surgery, ophthalmic surgery and face lift surgery.



Reference:

1. Suture materials: composition and applications in veterinary wound repair, RHH TAN, RJW BELL, BA DOWLING and AJ DART University Veterinary Centre Camden, The University of Sydney, 410 Werombi Road, Camden, New South Wales 2570
2. Sutures and suturing techniques in skin closure, Mohan H. Kudur , Sathish B. Pai, H. Sripathi, Smitha Prabhu
3. SRB's Surgical Operations: Text & Atlas by SRIRMA Bhat M (Professor, Department of surgery, Kasturba Medical College)
4. Surgical Technology - E-Book: Principles and Practice by Joanna Kotcher