
Suturing: Principles and Materials



Goals of suturing

- Provide adequate tension
- Permit primary intention healing by approximating edges
- Maintain homeostasis
- Provide support for tissue margins
- Reduce post-operative pain
- Prevent underlying tissues exposure

What's an ideal suture?

1. Can be used in any tissue or procedure
2. **Minimal tissue reaction** *“non-allergenic, non-carcinogenic, non-capillary, non-electrolytic”*
3. **High tensile strength**
4. **Good knot security**
5. Favorable absorption profile
6. Predictable performance
7. Low cost

What factors determine suture selection?

- Surgeon familiarity with the suture
- Physical and biological characteristics of the suture
- Healing characteristics of the tissue
- Presence of infection or contamination
- Cosmetic results

What factors determine suture selection?

All sutures should be avoided in infected wounds because as foreign bodies, sutures can impair wound healing.

If sutures must be used in such situations, **monofilament, non-absorbable** material should be used

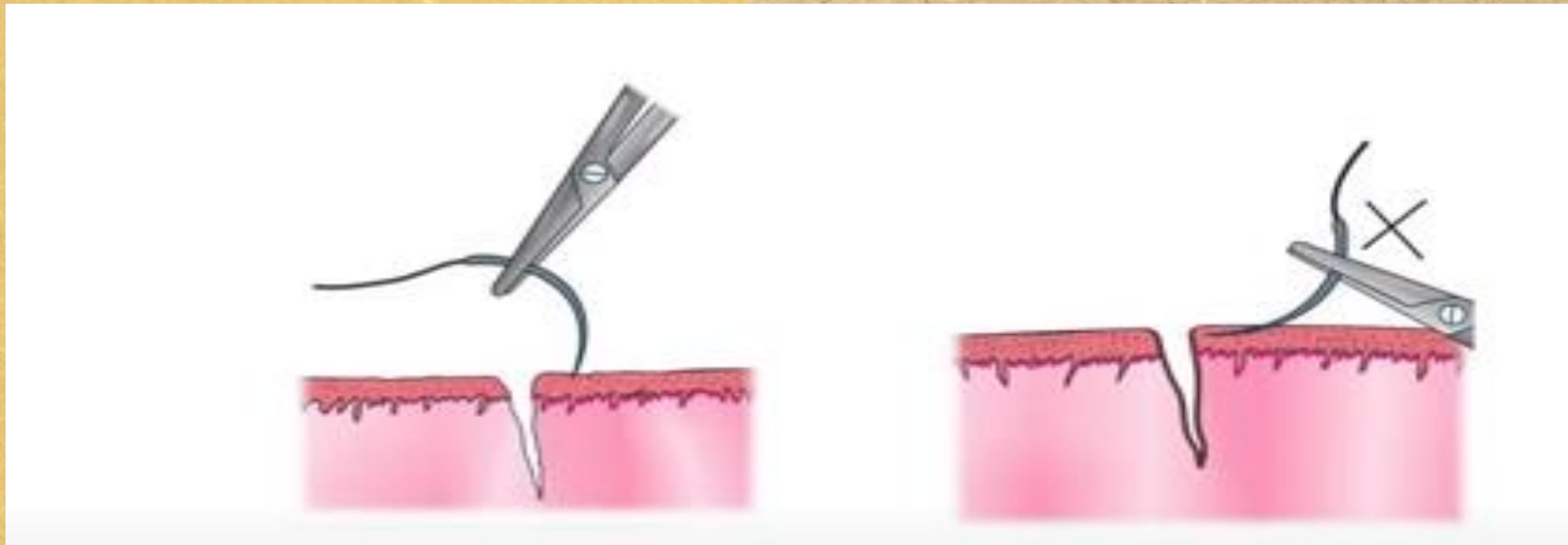
Principles of suturing

The needle should be grasped at approximately $1/3^{\text{rd}}$ the distance from the swaged area “the eye” and $2/3^{\text{rd}}$ from the point



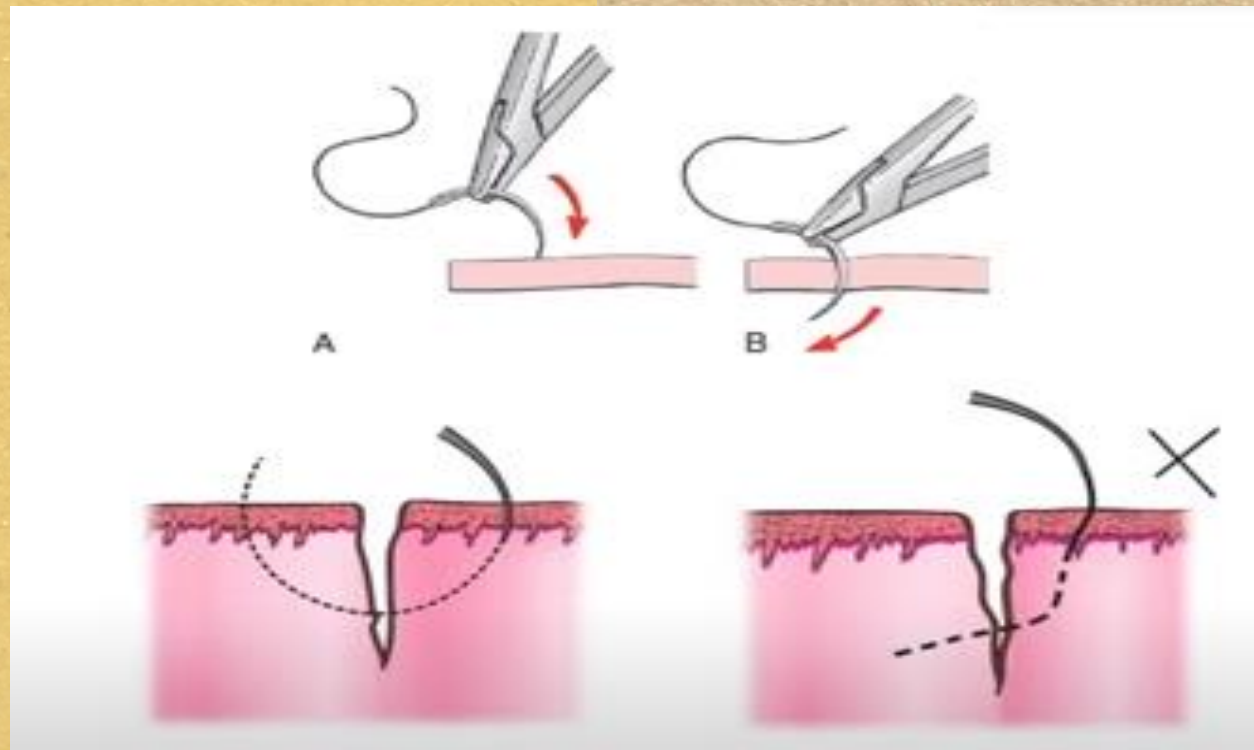
Principles of suturing

The needle should enter the tissues perpendicular to the tissue surface



Principles of suturing

The needle should be passed through the tissues along its curve



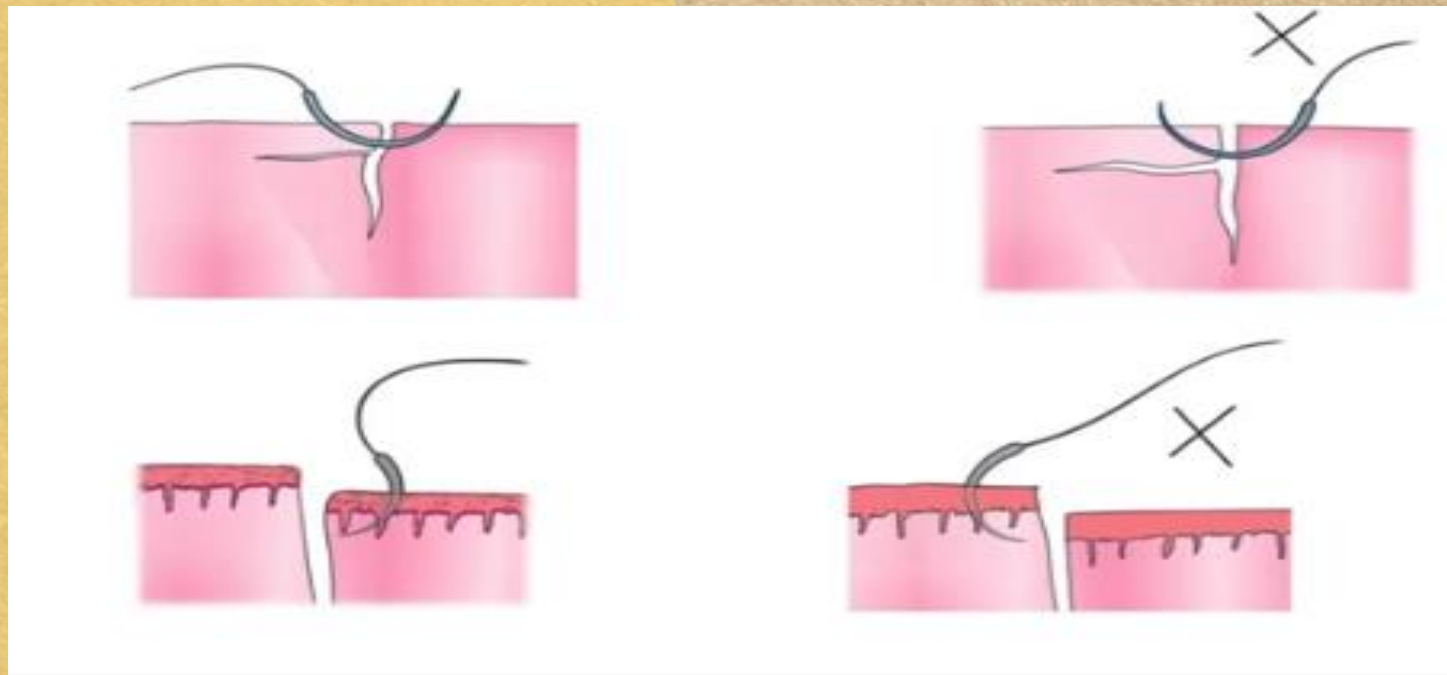
Principles of suturing

The needle should be passed at an equal depth and distance from the incision on both sides to prevent overlap and improper approximation



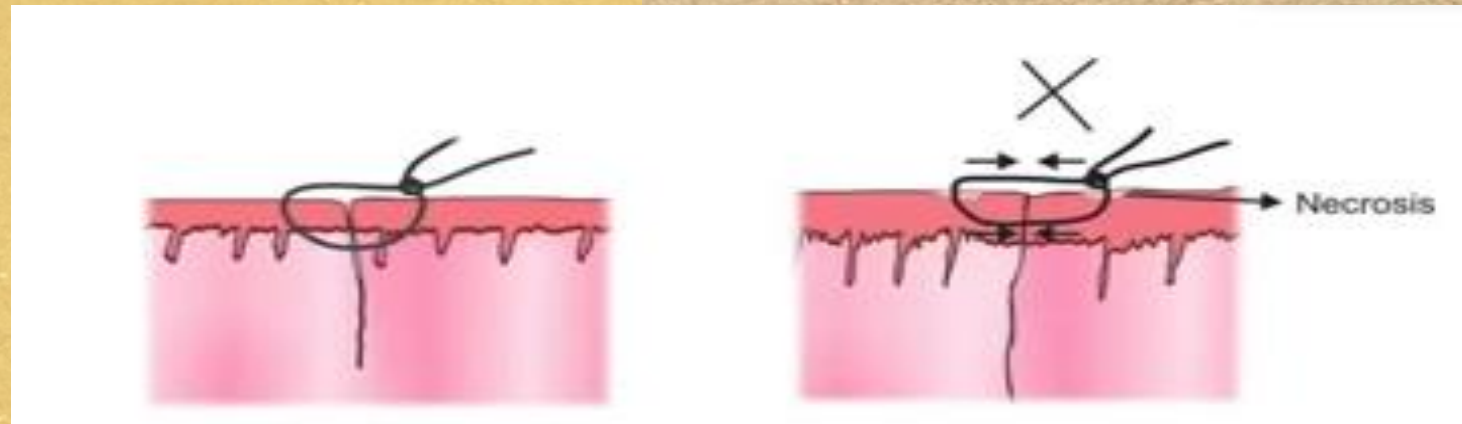
Principles of suturing

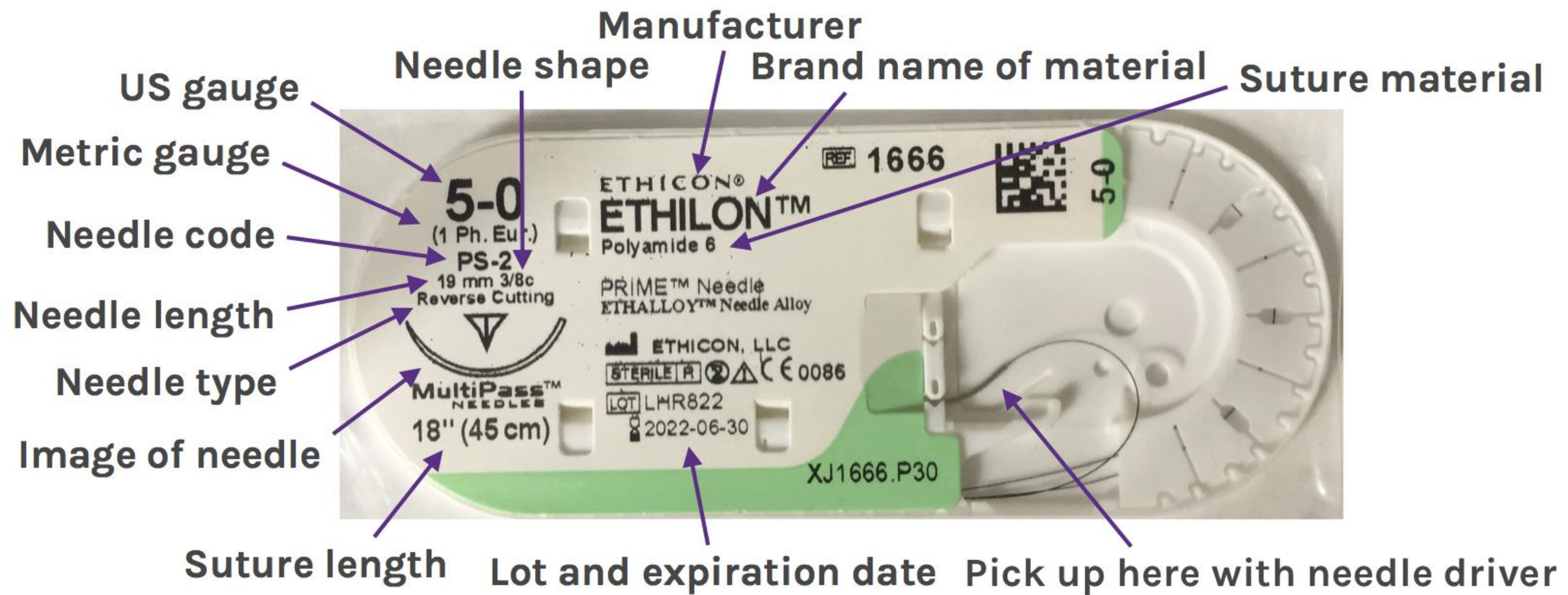
The needle should pass from the thinner tissue to the thicker one and from the deeper to the superficial one.



Principles of suturing

1. Tissues should never be closed under tension
“Approximate, do not strangulate”





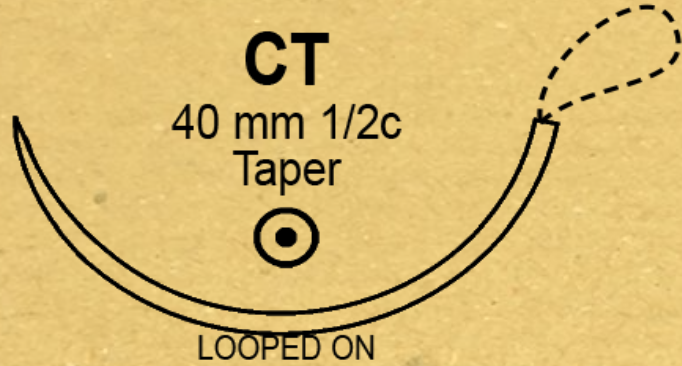
0

(3.5 metric)

50" (125 cm)

CT

40 mm 1/2c
Taper



LOOPED ON

D5498
SPECIAL ORDER

PROLENE*

(Polypropylene) Suture
BLUE MONOFILAMENT

3 DOZEN, Sterile, Nonabsorbable Surgical Suture.
U.S.P.

ETHICON*



See instructions for use

Do not reuse/resterilize.

STERILE | EO

*Trademark



4-0
(1.5 metric)
18" (45 cm)

J109T

Coated
VICRYL*
(Polyglactin 910) Suture
UNDYED BRAIDED

12 Strands Per Packet
SINGLE STRAND DELIVERY

2 DOZEN, Sterile, Synthetic Absorbable Suture.
U.S.P. except for diameter.

ETHICON*

Do Not Resterilize.
*Trademark

EXP
LOT

Disclaimer: Needle sizes displayed on the Ethicon Product Center may vary depending on computer/tablet/smartphone screen ratios.

5-0

(1.0 metric)

8" (20 cm)

OPS-5

13 mm 1/2c

Spatula



ETHALLOY* Needle Alloy
MICRO-POINT* SURGICAL NEEDLE

D6870

SPECIAL ORDER

PROLENE*

(Polypropylene) Suture

BLUE MONOFILAMENT

EXP

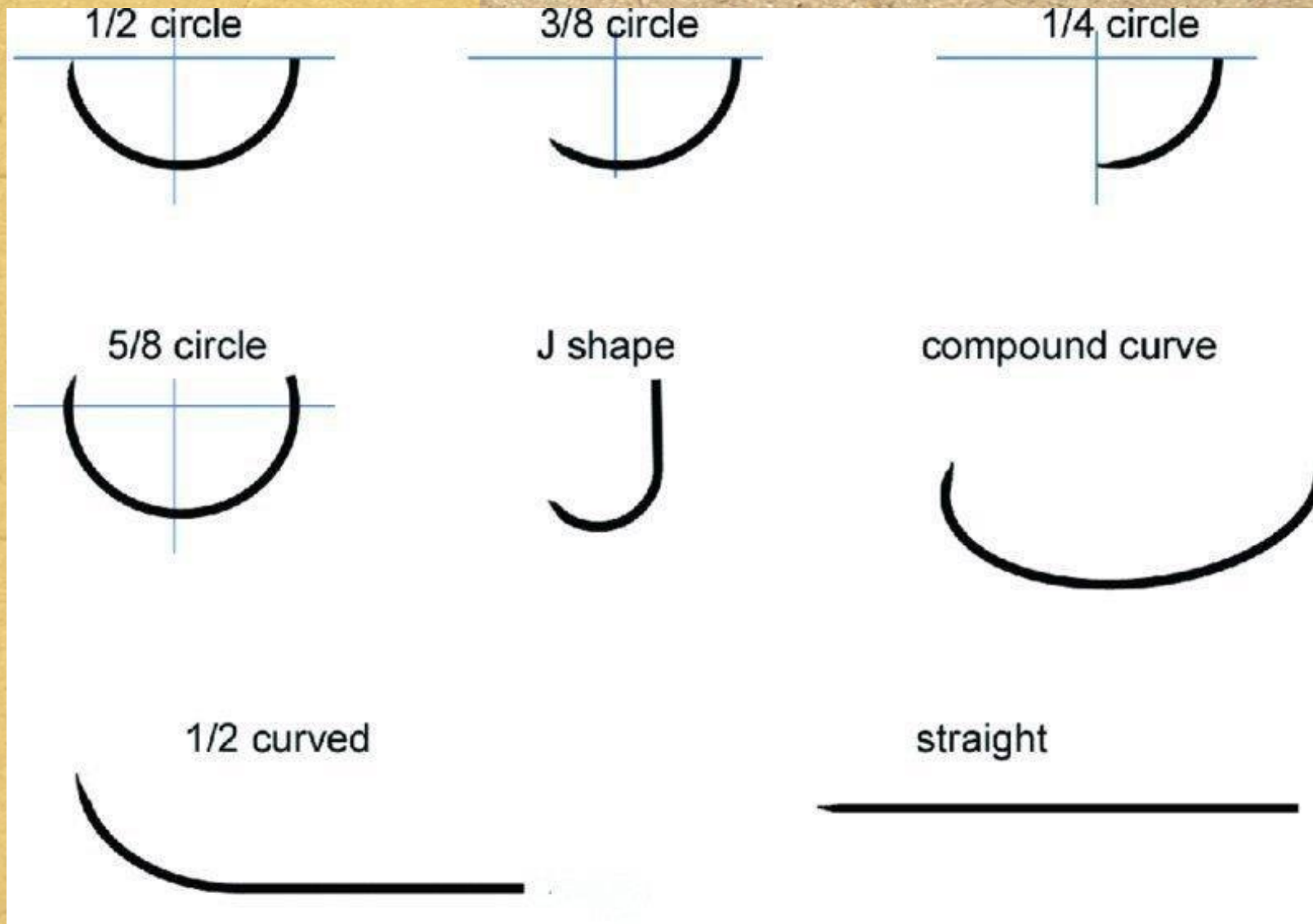
LOT

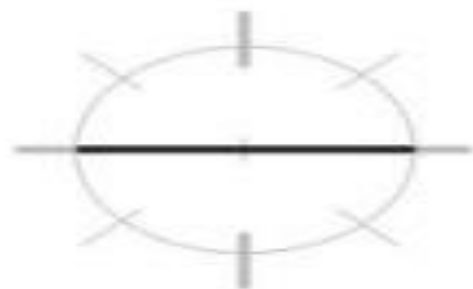
3 DOZEN, Sterile, Nonabsorbable Surgical Suture,
U.S.P.

ETHICON*

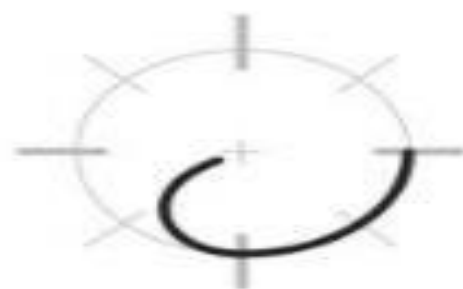
Do Not Resterilize.
*Trademark

Needle Shapes

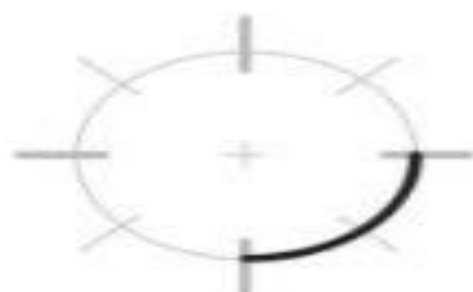




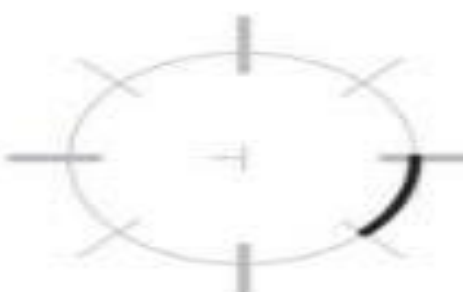
Straight (aka: Keith): Skin Closure



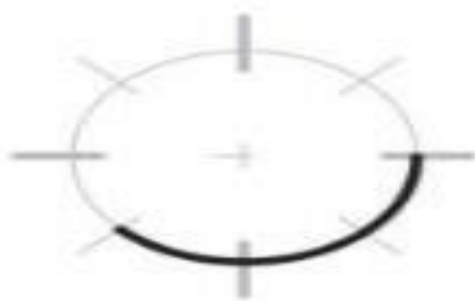
Bi-curve: Vasectomy Reversal, Ophthalmic



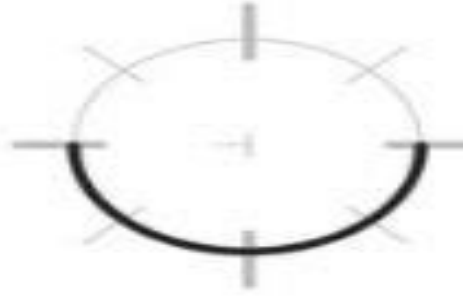
1/4 Circle: Ophthalmic



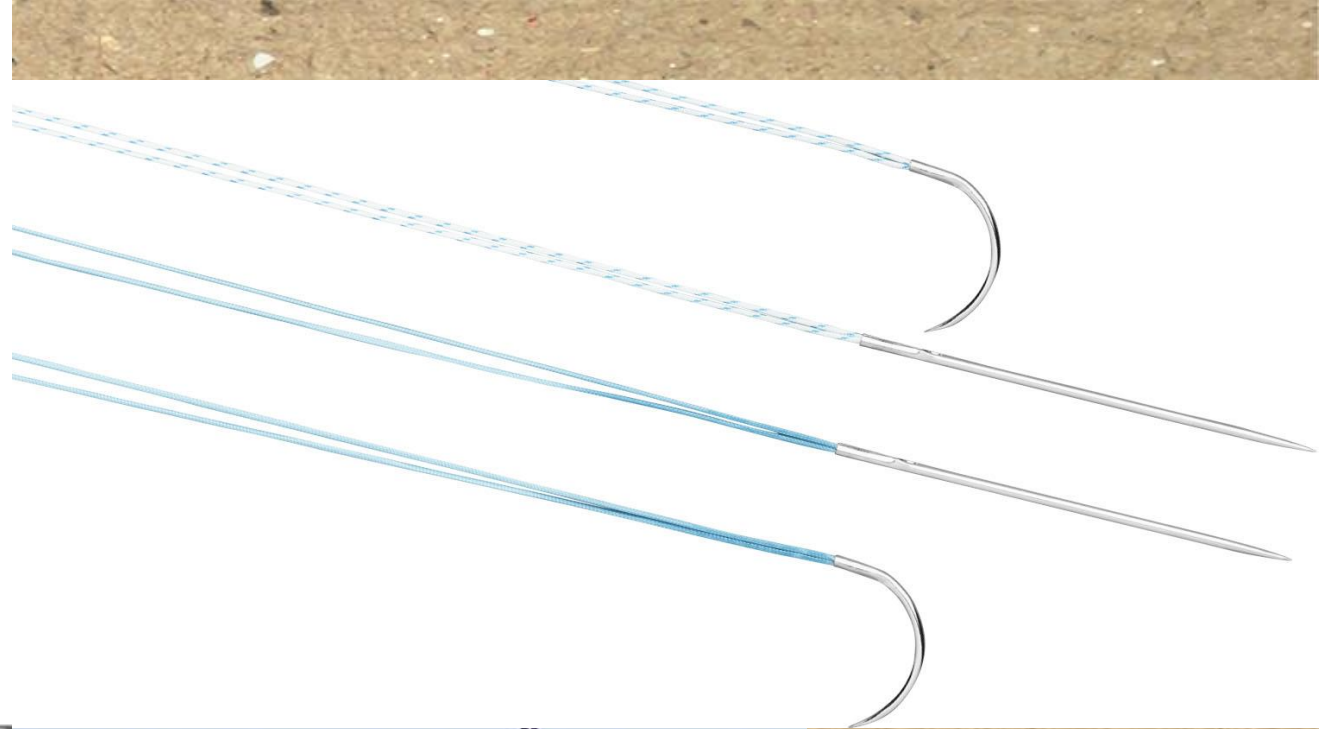
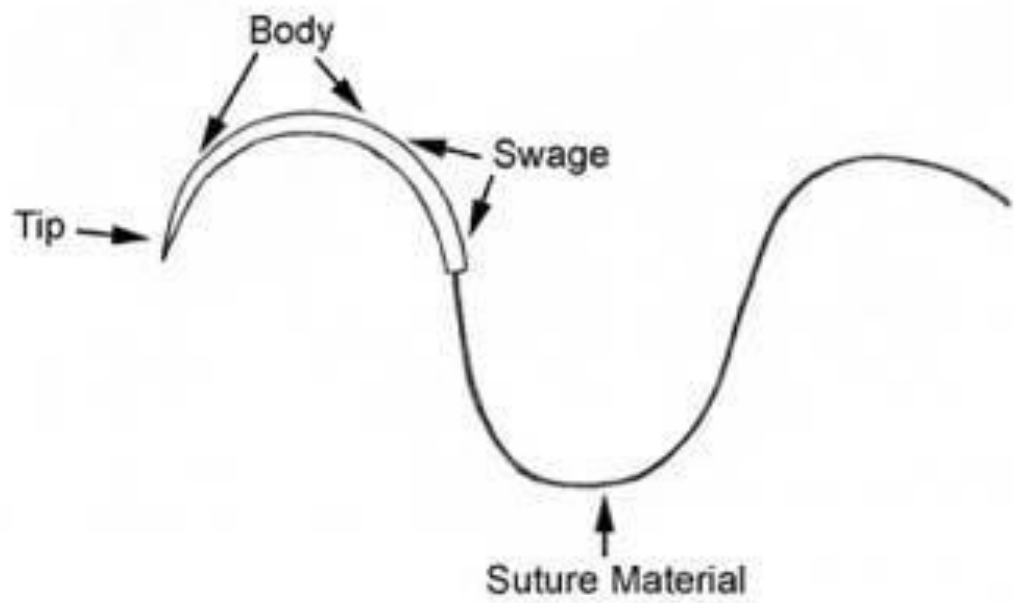
1/8 Circle: Ophthalmic



3/8 Circle: Skin Closure, Ophthalmic



1/2 Circle: Skin Closure, GI,
Cardiovascular, Ophthalmic



Suture Attachments

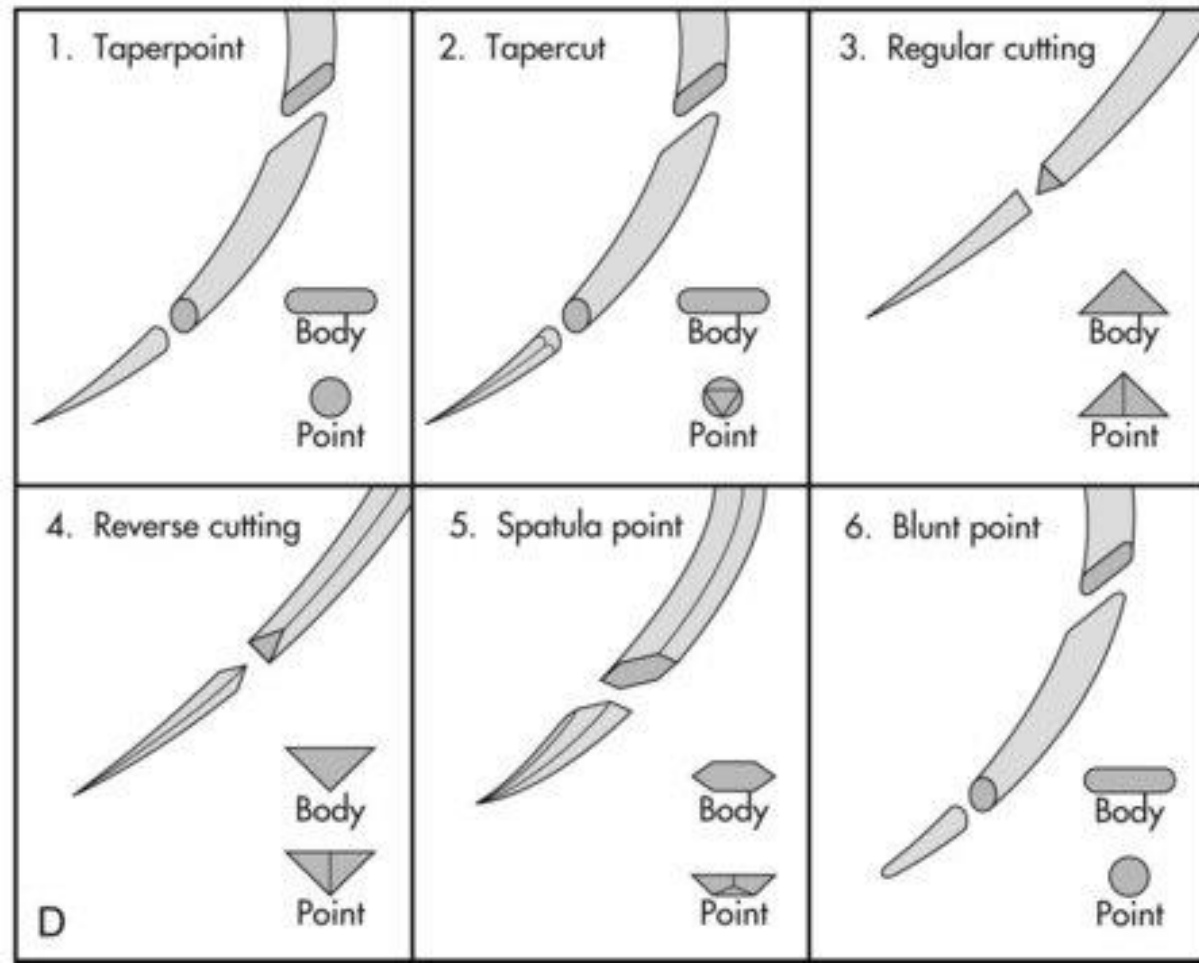
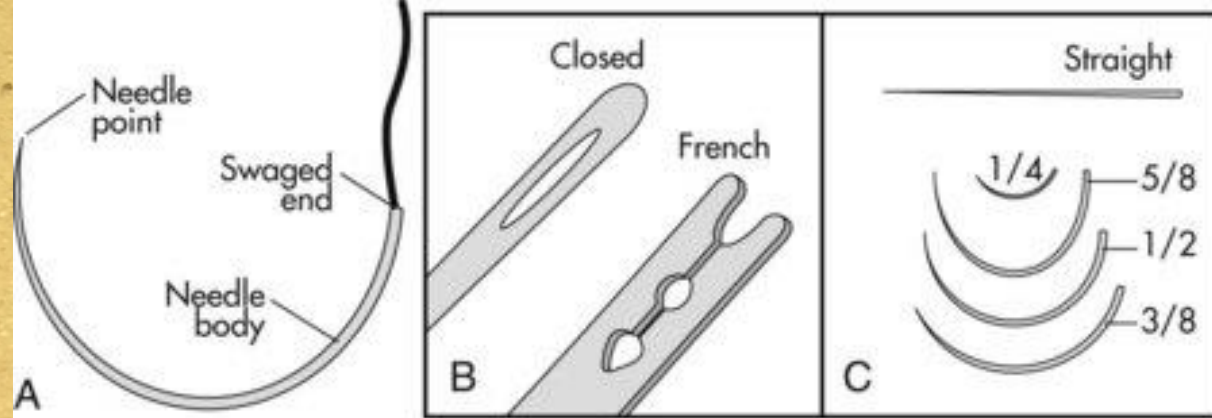
Types of suture attachments







Eyed needle



Swaged (atraumatic)
needle



Needle Point

	Taper-Point	<ul style="list-style-type: none">• Suited to soft tissue• Dilates rather than cuts
	Reverse cutting	<ul style="list-style-type: none">• Very sharp• Ideal for skin• Cuts rather than dilates
	Conventional cutting	<ul style="list-style-type: none">• Very sharp• Cuts rather than dilates• Creates weakness allowing suture tear out
	Taper cutting	<ul style="list-style-type: none">• Ideal In tough or calcified tissues• Mainly used in cardiac and vascular procedures

Suture Sizes

SYNTHETIC SUTURE MATERIALS (USP)	SURGICAL GUT (USP)	BROWN AND SHARPE WIRE GAUGE	METRIC GAUGE	ACTUAL SIZE (MM)
10-0			0.2	0.02
9-0			0.3	0.03
8-0			0.4	0.04
7-0	8-0	41	0.5	0.05
6-0	7-0	38-40	0.7	0.07
5-0	6-0	35	1	0.1
4-0	5-0	32-34	1.5	0.15
3-0	4-0	30	2	0.2
2-0	3-0	28	3	0.3
0	2-0	26	3.5	0.35
1	0	25	4	0.4
2	1	24	5	0.5
3,4	2	22	6	0.6
5	3	20	7	0.7
6	4	19	8	0.8
7		18	9	0.9

Biological vs. Synthetic

- Biological sutures:
 - Pros: Easy handling and knotting and tend to be stronger
 - Cons: high tissue reaction and require strict storage requirement
- Synthetic sutures:
 - Pros: Less tissue reaction
 - Cons: more difficult to handle and knot

Absorbable vs. non-absorbable

- ❖ Absorbable suture:

A suture that degrades and loses its tensile strength within 60 days; it provides temporary wound support. Typically used for deep tissues and subcuticular skin closure

Examples: Catgut, Vicryl, PDS

Absorbable vs. non-absorbable

- ❖ Non-absorbable sutures:

A suture that offers longer mechanical support > 60 days.

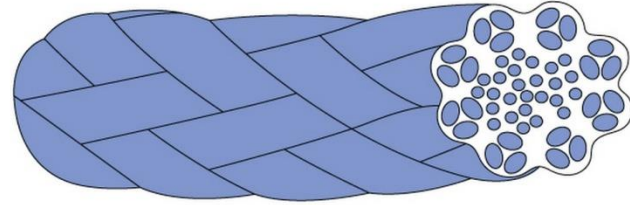
Complete absorption usually takes several months. They provoke less immune reaction thus less scarring. Used for skin and some deep structures like vessels or nerves or tendons.

Examples: Silk, Nylon, Prolene

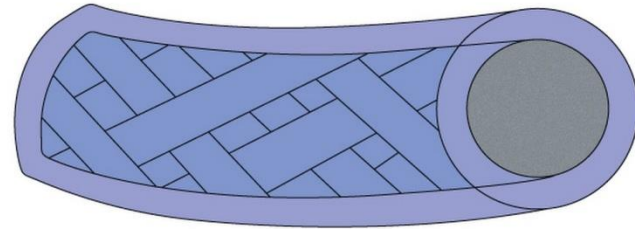
Absorbable vs. non-absorbable

- ❖ Absorption occurs by either **enzymatic degradation** in natural material which causes intense tissue reaction or by **hydrolysis** in synthetic materials which causes less tissue reaction.
- ❖ Non absorbable sutures get encapsulated or walled off “acellular reaction”.

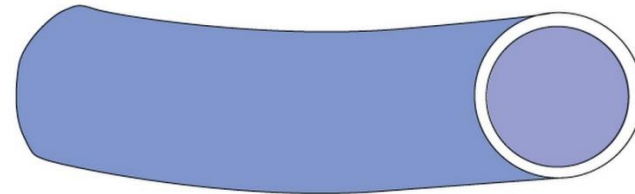
Multifilament



Multifilament coated



Monofilament



Monofilament vs. Multifilament

- ❖ Monofilament suture is made of a single strand
 - Smooth surface; glides through tissues easily = “less tissue trauma”
 - No capillarity; relatively more resistant to infection
 - Less tissue reaction
 - Good memory; more difficult to handle
 - Poor knot security and higher knot slippage

Monofilament vs. Multifilament

- ❖ Multifilament suture is composed of several filaments braided or twisted together and thus providing high surface area
 - More tissue drag
 - May initiate infection “high capillarity”
 - Higher tissue reaction
 - More pliable and easier to handle
 - It generally has a greater tensile strength and knot security

Sutures Materials

Suture Type	<i>Absorbable</i>	<i>Non-absorbable</i>	<i>Monofilament</i>	<i>Multifilament</i>
Vicryl	✓			✓
PDS*	✓		✓	
Monocryl	✓		✓	
Nylon		✓	✓	
Prolene		✓	✓	
Silk		✓		✓

CATGUT Sutures



CATGUT Sutures

- Absorbable , Natural, multifilament
- Collagen fibers from sheep intestinal submucosa or bovine intestinal serosa
- High tissue reactivity; absorbed by proteolytic digestive enzymes released from inflammatory cells
- Capillary
- Maintain significant tensile strength for only 7–10 days, and stop providing wound security in 2 weeks
- Absorption is complete at 70-90 days

Vicryl (Polyglactin 910) Suture

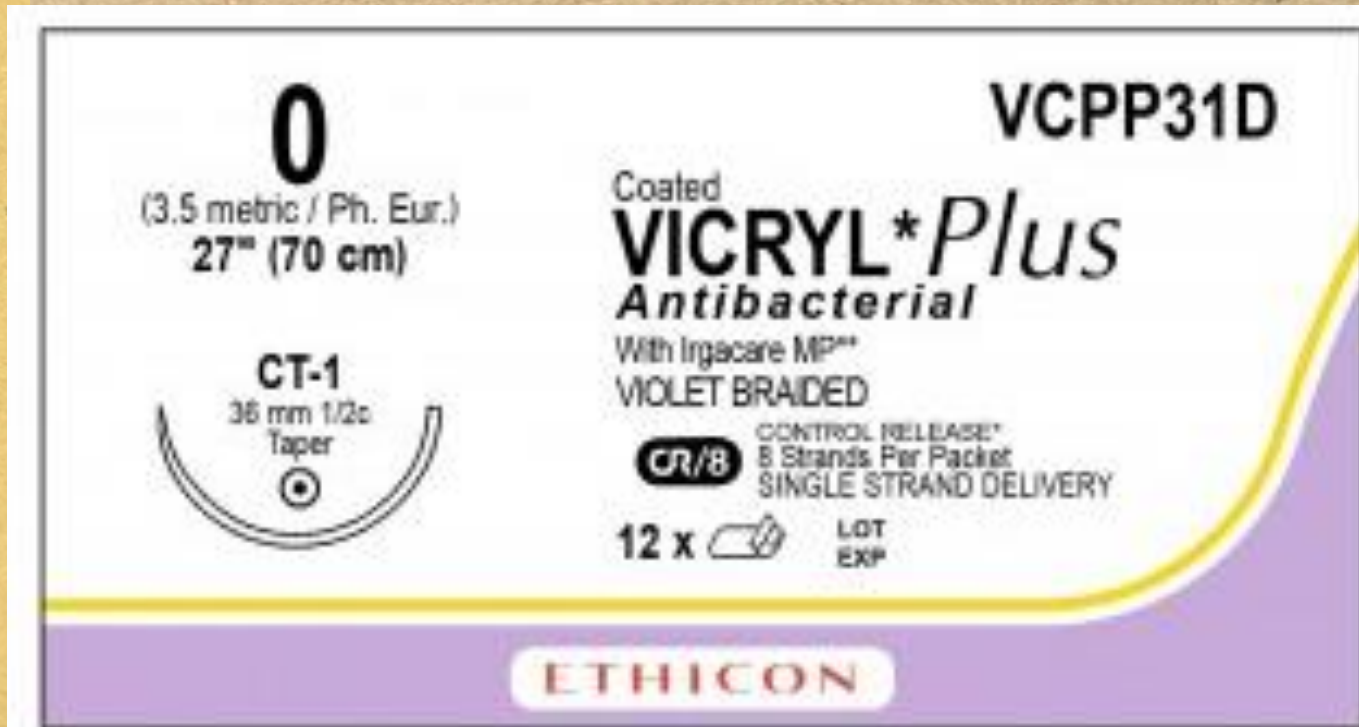


Vicryl (Polyglactin 910) Suture

- Absorbable, synthetic, Multifilament
- Minimal tissue reaction
- Break-down products inhibit bacterial growth
 - *Can be used in contaminated wounds, unlike other multifilaments*
- VICRYL Suture is indicated for use in general soft tissue approximation and/or ligation
- Maintain significant tensile strength for 14-21 days, and stop providing wound security in 3 weeks
- Complete absorption by hydrolysis at 70 days

VICRYL PLUS Suture

- Performs same as the regular vicryl
- Triclosan coating have been shown to decrease SSI rates.



Vicryl Rapide suture

- It has similar initial tensile strength as that of regular Vicryl suture
- Minimal tissue reaction
- Used when low tensile strength and rapid absorption rate is needed
- Maintain significant tensile strength for 5 days, and stop providing wound security in 2 weeks
- Complete absorption occurs in 30-40 days

- Examples: skin closure, particularly in pediatric surgery, episiotomies, circumcision and closure of oral mucosa

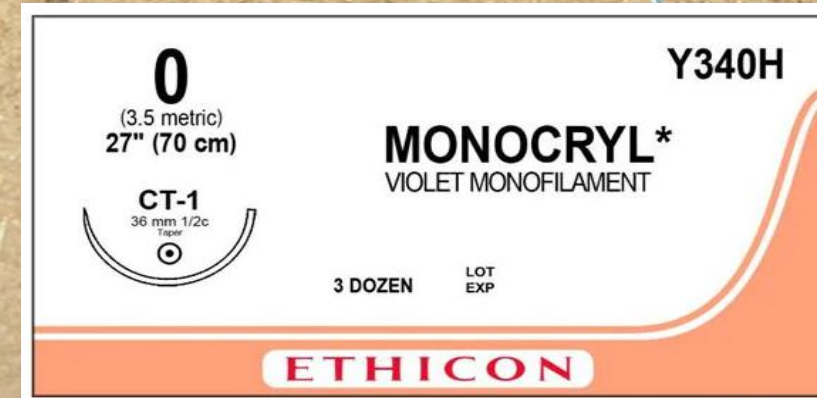


Vicryl (Polyglactin 910) Suture

1. Vicryl is widely used for:
 - a. skin and soft tissue closure Its softness makes it a good choice for wounds in awkward skin creases or sensitive areas (such as the perineum).
 - b. Suture ligation of blood vessels.
 - c. Abdominal surgery to repair perforations in the gastrointestinal tract or bladder, create a hand-sewn intestinal anastomosis or secure a stoma to the skin.
2. Vicryl should not be used on cardiac, vascular or nerve tissue.

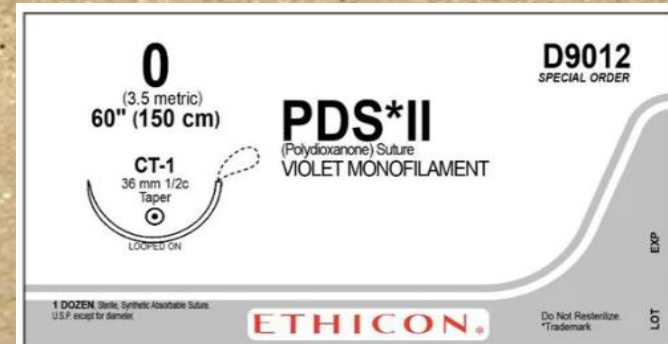
Monocryl Suture

- **Absorbable, synthetic, monofilament**
- Virtually zero tissue reactivity which may lead to decreased scar formation and better cosmetic results. Good knot strength
- Superior pliability for easy handling and tying.
- Used mainly for low-tension soft tissue closure and when low tissue reactivity is needed (subcuticular skin closure)
- Maintain significant tensile strength for 7 days, and stop providing wound security in 2 weeks
- Absorption is essentially complete at 90-120 days



PDS (Polydioxanone) Suture

- Absorbable , Synthetic, Monofilament
- Prepared from polydioxanone
- Stiff and difficult to handle
- These sutures are particularly useful where the combination of an absorbable suture and extended wound support (up to 6 weeks) is desirable.
- Only a slight tissue reaction
- For wound under tension and contaminated wounds
- Maintain significant tensile strength for 2-4 weeks, and stop providing wound security in 6 weeks
- Complete absorption after 6 months;



Silk Suture

- Non-absorbable, Natural, Multifilament
- Braided protein filaments spun by the silkworm larva
- After braiding, the strands are coated with silicon to decrease its capillarity.
- Easy to handle, good tensile strength, good knot security
- High reactivity, shouldn't be used in the presence of infection.
- Maintain significant tensile strength for 1 year, and stop providing wound security in 2 years



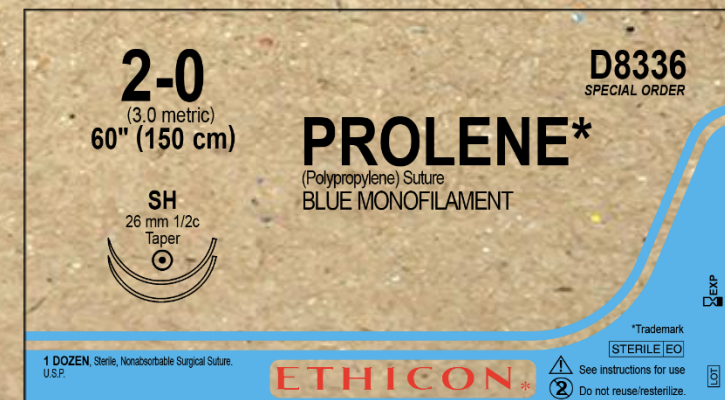
Nylon Suture

- **Non-absorbable, Synthetic, Monofilament**
- Made of inert polyamide polymer
- Very little tissue reactivity
- Poor knot security... Knot slippage is very common.
- **High memory;** returns to original linear shape over time
- High tensile strength, loses 15% of its tensile strength every year



Prolene suture

- Non-absorbable , Synthetic, Monofilament
- Polymer of Propylene
- Holds knots better than other synthetic sutures
- Minimal tissue reaction; used in contaminated and infected wounds
- PROLENE sutures do not adhere to tissue
- Efficacious as a pull-out suture.
- Widely used in plastic and cardiovascular surgery
- Will not lose tensile strength over time “for up to 2 years”



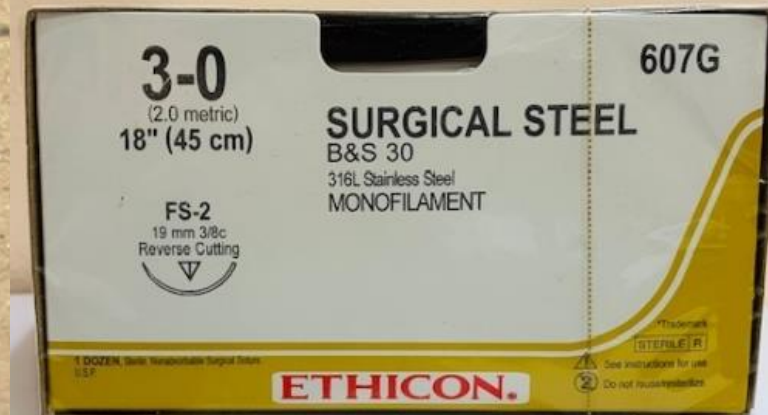
Ethibond Suture

- Non-absorbable , Synthetic, **multifilament**
- Made of polyester polymers
- Special coating (silicon) is added for:
 - Lower infection rate
 - Lower reactivity
 - More secure knotting
 - Smoother surface and less tissue damage
- Tensile strength is maintained indefinitely



Surgical wire: Stainless Steel Suture

- **Non-absorbable, Synthetic, Monofilament or multifilament**
- Good knot security
- Very little tissue reaction
- The Strongest
- Difficult to handle or tie
- Extra care during use to avoid accidental soft tissue injury → Can cut through tissues
- Used to approximate bone or strong tendons (i.e. sternotomy)



When to remove sutures?

- Sutures should be removed within 1-2 weeks of their placement, depending on the anatomic location.
- Prompt 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.
- To prevent dehiscence and spread of the scar, sutures should not be removed too soon.

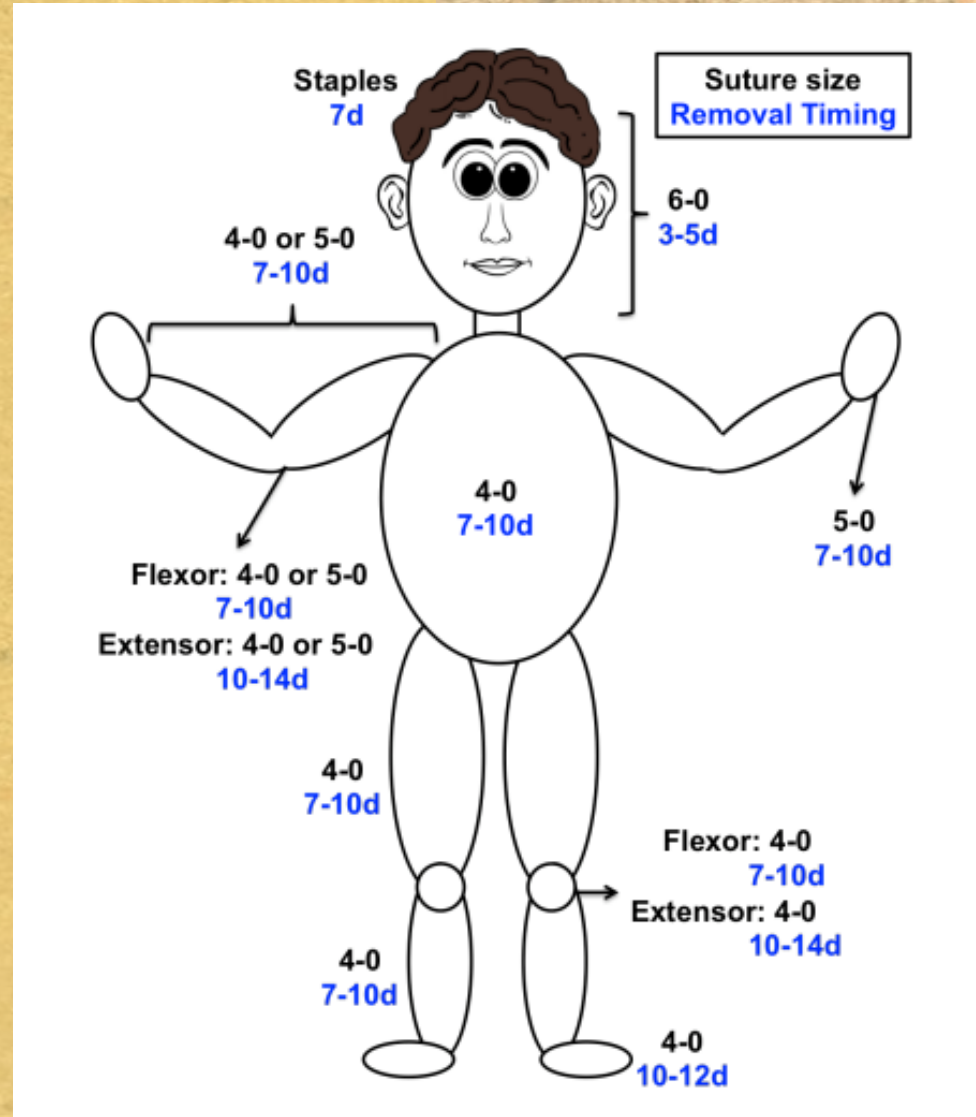
When to remove sutures?

- In general, the greater the tension across a wound, the longer the sutures should remain in place.
- Skin thickness, tissue regeneration time, site near joints are all factors that affect the duration.

When to remove sutures?

- As a rough guide:
 - On the face, sutures should be removed in 5-7 days;
 - Neck, 7 days;
 - The scalp, 10 days;
 - On the trunk and upper extremities, 10-14 days;
 - On the lower extremities, 14-21 days.

When to remove sutures?



Area	Size	Type	Days to Removal
Scalp	Staples or 4-0 or 5-0	non absorbable	7
Ear	6-0	non absorbable	5-7
Eyelid	6-0 or 7-0	absorbable or nonabsorbable	5-7
Eyebrow	5-0 or 6-0	absorbable or nonabsorbable	5-7
Nose	6-0	absorbable or nonabsorbable	5-7
Lip	6-0	absorbable	NA
Oral mucosa	5-0	absorbable	NA
Other face / forehead	6-0	absorbable or nonabsorbable	5
Chest/abdomen	4-0 or 5-0	non absorbable	12-14
Back	4-0 or 5-0	non absorbable	7-10
Extremities	4-0 or 5-0	non absorbable	7-10
Hand	5-0	non absorbable	7-10
Foot / Sole	4-0	non absorbable	12-14
Joint (Extensor)	4-0	non absorbable	10-14
Joint (Flexor)	4-0	non absorbable	7-10
Vagina	4-0	absorbable	NA
Penis	5-0	non absorbable	7-10
Scrotum	5-0	non absorbable	7-10

Suture Materials	Brand	Absorption		Coating		Suture Finish	
		Absorbable	Non-Absorbable	Coated	Uncoated	Monofilament	Multifilament
Polyglactin	<i>Petcryl 910</i>	✓		✓			✓
Polyglycolic Acid	<i>Petcryl 910</i>	✓		✓			✓
Poliglecaprone	<i>Petcryl Mono</i>	✓			✓	✓	
Polydioxanone	<i>Duracryl</i>	✓			✓	✓	
Catgut Chromic	<i>Progut</i>	✓		✓		✓	
Catgut Plain	<i>Progut</i>	✓			✓	✓	
Silk	<i>Sutura</i>		✓	✓			✓
Nylon/Polyamide	<i>Linex</i>		✓			✓	
Polypropylene	<i>Duracare</i>		✓		✓	✓	
PVDF	<i>Duralene</i>		✓		✓	✓	
Polyester	<i>Procare</i>		✓	✓			✓
UHMWPE	<i>Ultrasut</i>		✓		✓		✓
PTFE	<i>Teflene</i>		✓		✓	✓	
Stainless Steel	<i>Dolphin Steel</i>		✓		✓	✓	

Others

Skin staples (or clips)

Made from stainless steel.

Can close various traumatic wounds

frequently used to close surgical incisions in situations where subcuticular suturing is not appropriate

Staples are preferred in heavily contaminated cases (such as faecal peritonitis) which have a high risk of post-operative wound infection.



Others

Skin glue

A fast-acting adhesive liquid made from cyanoacrylate (also known as 'super glue').

Can be used as a primary skin closure technique for small linear wounds and an effective dressing. It is safe, strong, atraumatic and seals the wound with a waterproof coating which flakes off on its own after 5-10 days.

It requires healthy skin edges under minimal tension, which may necessitate some deep dermal or subcuticular sutures.



Thank you.

<https://geekymedics.com/suture-material/>

https://youtu.be/TFwFMav_cpE?feature=shared