Semmelweis University
Faculty of Dentistry
Department of Oro-Maxillofacial Surgery and Stomatology

Sutures and Suture Materials in Oral Surgery

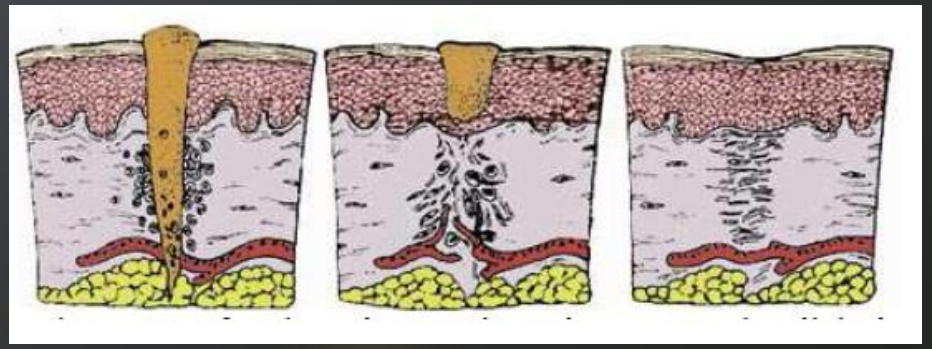
2016

Wound healing

PRIMARY (PER PRIMAM INTENTIONEM, PER PRIMAM, PP)

Galenus: the main task of the doctor: gapless wound closeur and linear scar healing

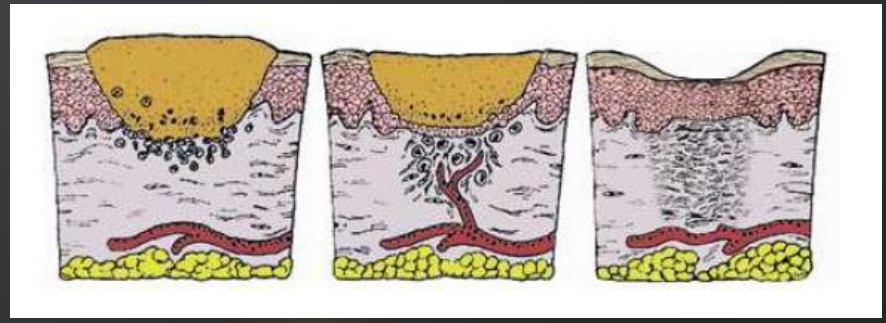
In primary wound healing there is no tissue loss. Incised wound is held together by a blood clot and possibly by sutures. An inflammatory process begins in adjacent tissue at the moment of injury. After several days, granulation tissue forms as a result of migration of fibroblasts to the area of injury and formation of new capillaries. Epithelial cells at wound margin migrate to clot and seal the wound. Regenerating epithelium covers the wound. Scarring occurs as a granulation tissue matures and injured tisssue is replaced with connective tissue



Wound healing

SECONDARY (PER SECUNDAM INTENTIONEM, PER SEC)

Healing by second intention occurs when there is tissue loss, as in extensive burns and deep ulcers. The healing process is more prolonged than in healing by primary intention because large amounts of dead tissue must be removed with viable cells. Open area is more extensive, inflammatory reaction is more widespread and tends to become chronic. Healing may occur under a scab formed of dried exudate, or dried plasma proteins and dead cells. Fibroblasts and capillary buds migrate toward center of would to form granulation tissue, which becomes a translucent red color as capillary network develops. Granulation tissue is fragile and bleeds easily. As granulation tissue matures, marginal epithelial cell migrate and proliferate over connective tissue base to form a scar. Contraction of skin around scar is the result of movement of epithelial cells toward center of wound in an attempt to close the defect. Surrounding skin moves toward center of wound in an effort to close the defect.



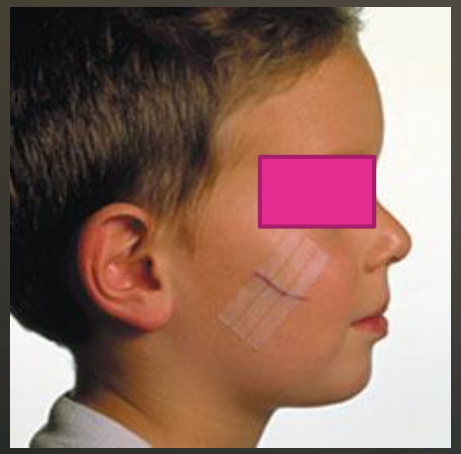
Wounds of various origins

- Puncture wound (vulnus punctum)
- Incised wound (vulnus scissum)
- Cut wound (vulnus caesum)
- Contuse wound (vulnus contusum)
- Lacerated wound (vulnus lacerum)
- Gunshot wound (vulnus sclopetarium)
- Bite wound (vulnus morsum)
- Burn wound (chemical, fire)
- Radiation wound

Methods of uniting wound edges

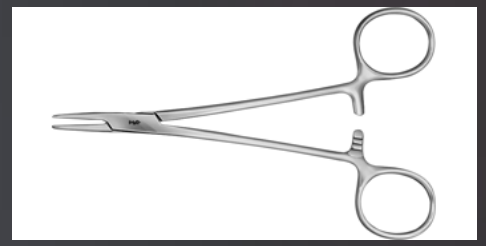
The basic condition for wound healing to be accurate and free of tension suturing, not to create blind spots and ensure optimal blood flow to the wound.

- Surface adhesives (eg. Steri Strip)
- Tissue adhesives (eg. human fibrin adhesives)
- Clamps
- Sutures



Necessary for suturing

- Suture material
- Needle
- Needle holder
- (Tweezers)
- (Surgical scissors)



Selection of suture materials

The choice of suture materials should be based on the physical and biological characteristics of the suture material and the healing properties of the sutured tissue

Factors influencing selection includes:

- Adequate tensile strenght
- Should hold tissue together safety
- Should be no stronger than sutured tissue
- Secured knots to prevent loosening of suture material which can be affected by:
  - Type of suture material
  - Length of the cut end
- Should be easy to handle
- Minimal tissue reaction
- Condition of sutured tissue (dirty, contaminated or infected wound)

Characteristics of the ideal suture material

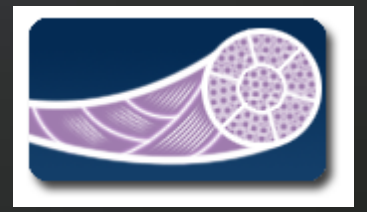
- Optimal characteristics of application (flexibility, slides well in tissues, easy to tie a knot, knot safety)
- Minimal tissue trauma
- High tear strength, should hold edges together until healing
- Minimal tissue reaction
- Complete resorption or removable
- Other important characteristics: thickness, elasticity, capillarity, structure, sterilization

Classification of suture materials

- Types of suture material according to origin:
  - natural
  - synthetic
- Types of suture material according to resorption:
  - non-absorbable suture materials
  - absorbable suture materials
- Types of suture material according to their structure/filament:
  - monofilament
  - multifilament
  - pseudomonofilament

Structure of suture materials

- *monofilament*: made of a single elementary fiber
- *multifilament*: made of a number of elementary filaments, twisted or braided
- *pseudomonofilament*: multifilament thread coated with some kind of material (eg. serous membrane, silicone, etilene-propilene, etc.)



Comparison of the monofilament and multifilament thread

	Monofilament thread 	Multifilament thread 
Advantages	Smooth surface Strong Low friction Lower resistance Less tissue trauma No bacterial culture No capillarity No tumor cell transport	Stronger Softness and flexibility Ease of use Knot safty
Disadvantages	Not very elastic Difficult handling and knotting	Rough surface Bacterial culture Capillarity Tumor cell transport Elongation Tissue trauma Tissue damage (kerf, sawing)

Comparison of natural and synthetic suture material

	Natural	Synthetic
Advantages	Easy to use Easy to knot	Economic Similar to the natural materials Absorption: hydrolisis Calcuable absorption Strength
Disadvantages	Absorption: enzymatic Tissue reaction Unpredictable absorption	The monofilaments difficult to handle

Comparison of non-absorbable and absorbable suture materials

	Absorbable	Non-absorbable
Advantages	It's degraded in the human body Not perceived as foreian matter No foreign body reaction	It keeps closure of the wound for unlimited time periode
Disadvantages	Closure of the wound is for a limited time period	Foreign matter Foreign body reaction Rejection of the suture

Natural absorbable suture material

- catgut:

  Animal intestine (cattle, sheep, goat, sometimes horse, donkey, mule, pig, but not cat!) purified, clean collagen fibres.

  Used by al-Zahrawi in the 10th century, also for instrument strings, bow strings, suturing.

  Resorption: proteolysis in 30-40 days, but reduced tensile strength after 7 days

- chromic catgut:

  Reduced tensile strength only after 18-21 days.

Synthetic, absorbable materials

- Polyglycolic acid (eg. Dexon)

  Keeps tensile strength (TS) for 1 week, after 3 weeks only 20%

- Polyglactin (eg. Vicryl)

  TS: 14 days, 50-70 days degradation

- Polydioxane (PDS)

  TS: 6 weeks, 90 days to 6 months degradation

- Polyglyconate (eg. Maxon)

  After 4 weeks 50% TS

Resorption: mainly hydrolysis

Natural, non-absorbable materials

- Silk – naturally strong multifilament or pseudomonofilament
- Steel
- Linen

Synthetic, non-resorbable materials

- Polyamide (eg. Supramid) – 6-0, 7-0 monofilament, thickers are multifilament, pseudomonofilament
- Polyester (eg. Dacron) – easy to handle, to make knots, holds the knot well, inflammatory reactions may occur
- Polypropylene (eg. Prolene) – strong, slides well, minimal tissue reaction, expensive, more difficult to handle, stubby suture ends
- Teflon (Gore-Tex)

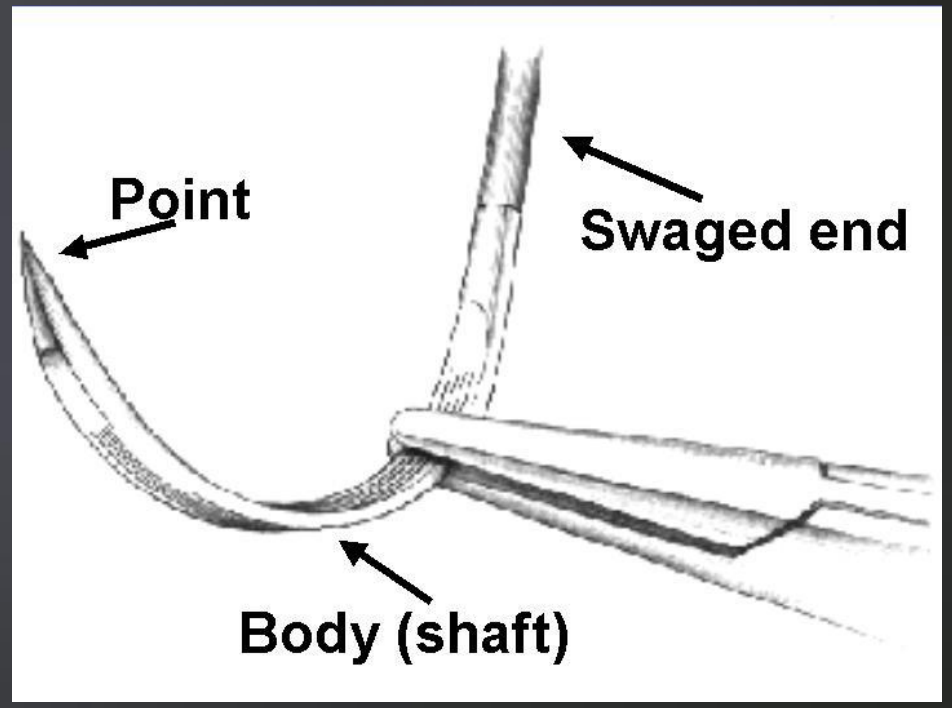
Size of suture materials

USP (United States Pharmacopeia)	Diameter (mm)
6	0.8
5	0.7
4	0.6
3	0.6
2	0.5
1	0.4
0	0.35
2-0	0.3
3-0	**0.2**
4-0	**0.15**
5-0	0.1
6-0	0.07
7-0	0.05
8-0	0.04
9-0	0.03
10-0	0.02
11-0	0.01

Needles

The ideal needles:

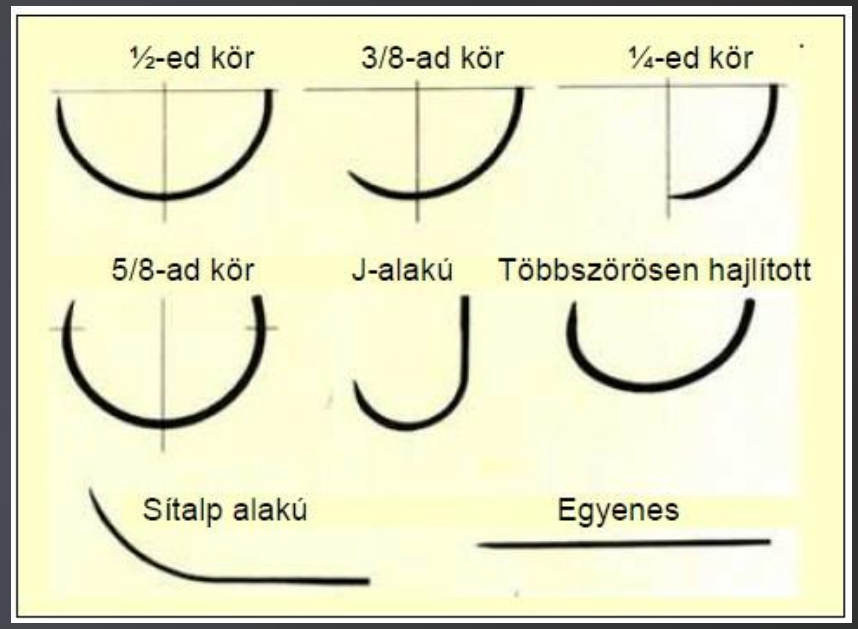
- Should be elastic
- Should strain resistant
- Should not bend easily
- Should not break



Needle shapes

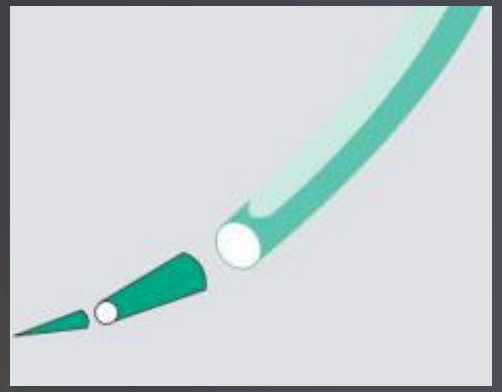
May have various shapes

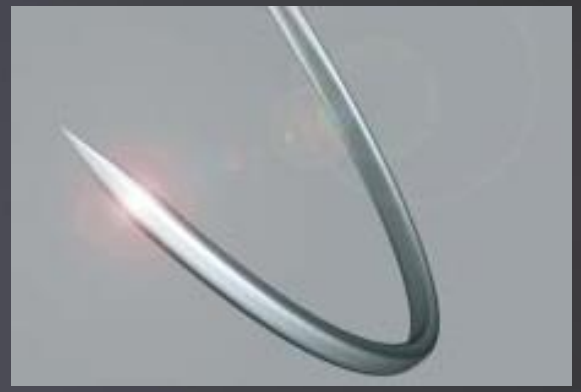
- 3/8ths of a circle (B-needle)
- 1/2 of a circle (G-needle)



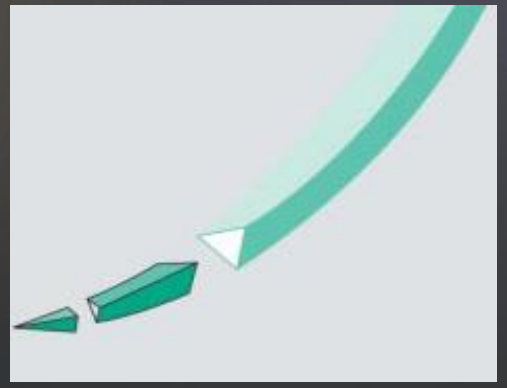
Cross section of the needle

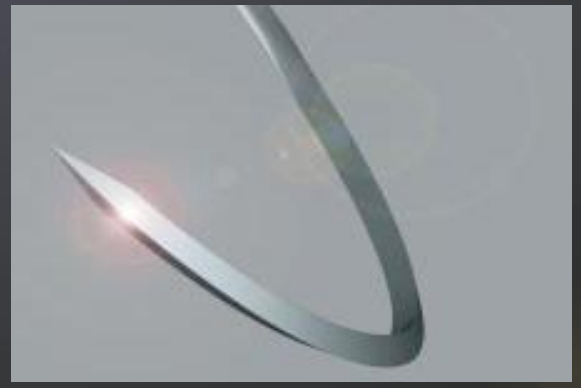
- Round





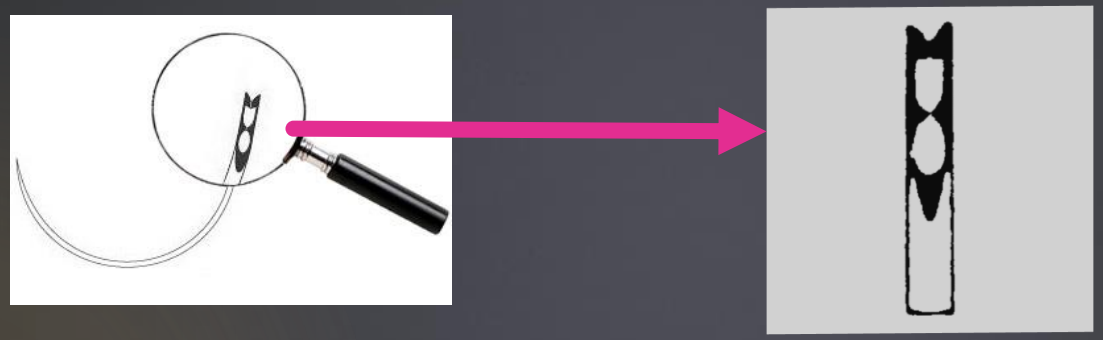
- Triangular (cutting needle)



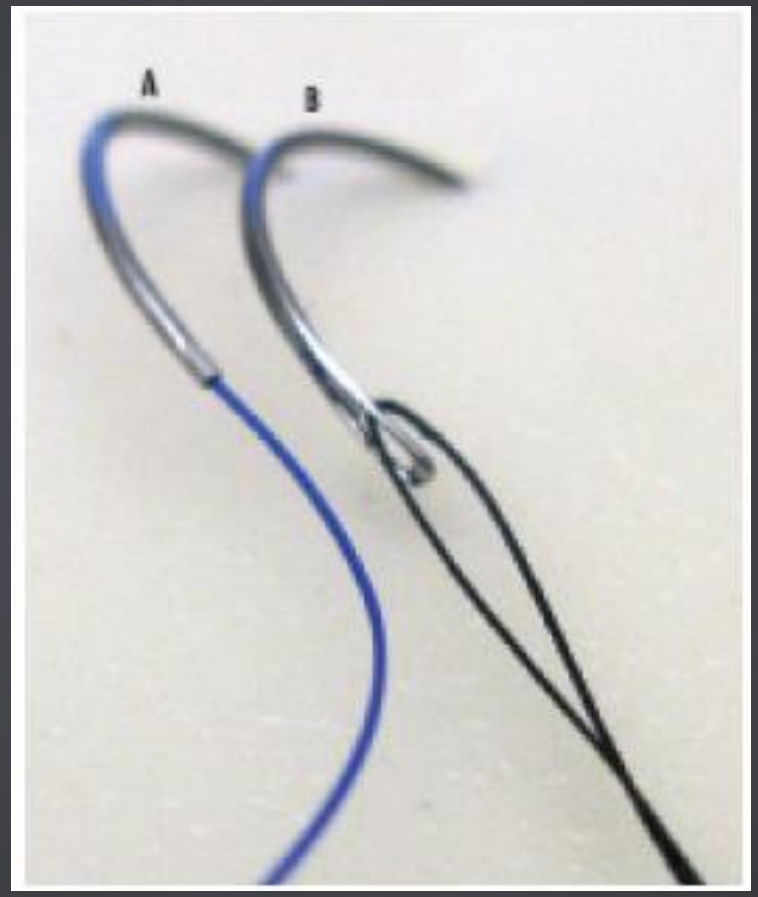


Traditional and atraumatic needles

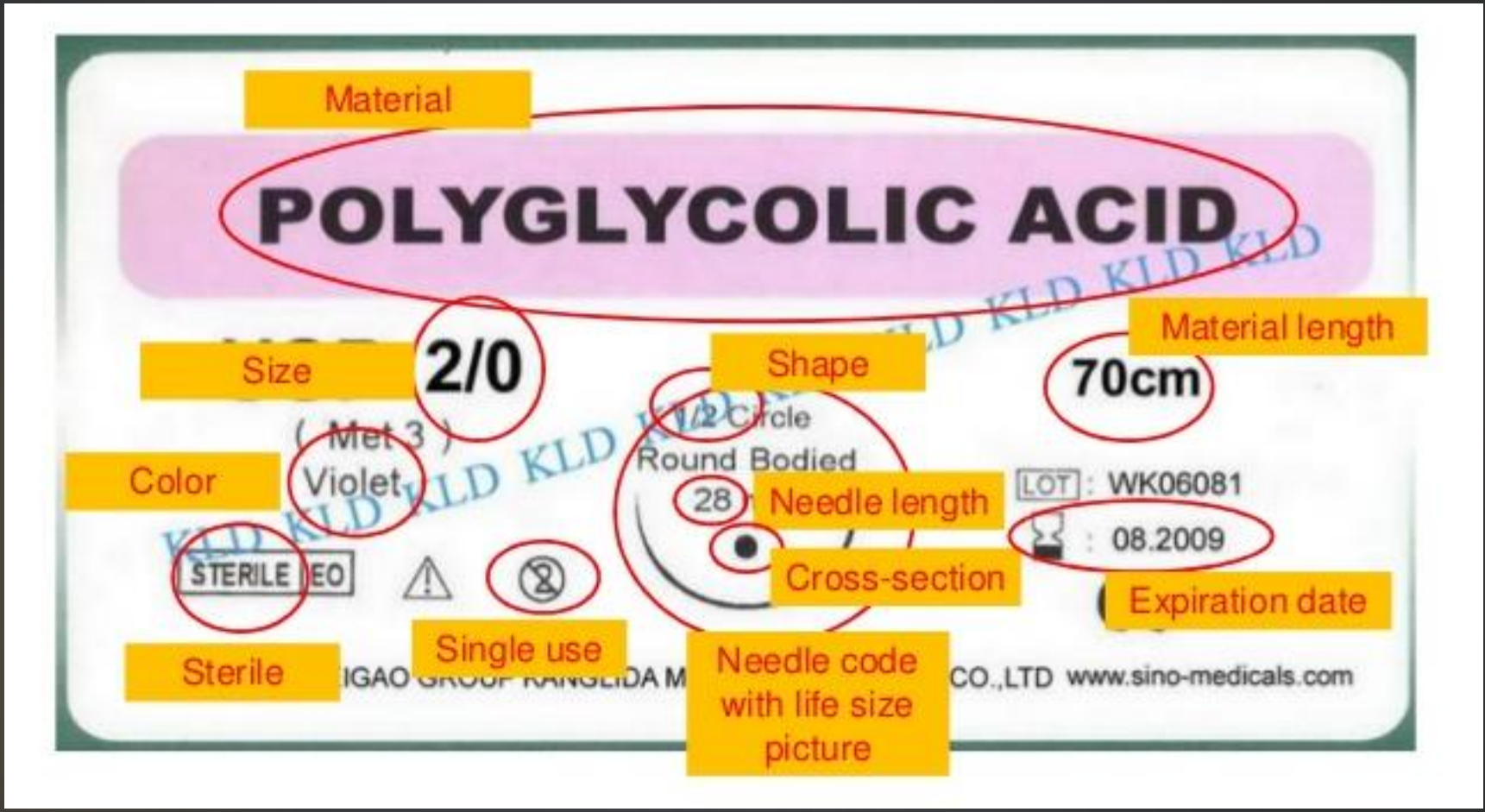
- End of a traditional needle



- Atraumatic suture material

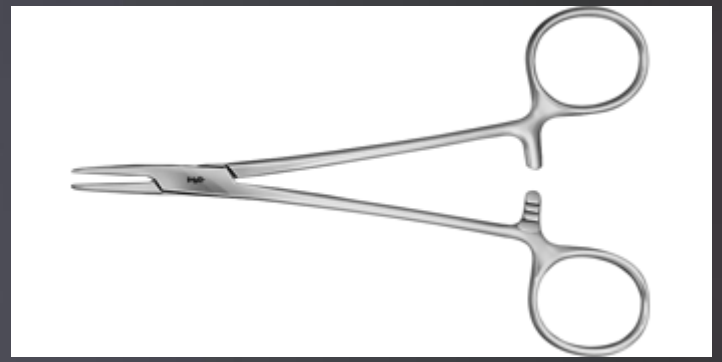

A
B

Suture material / needle



Needle holder

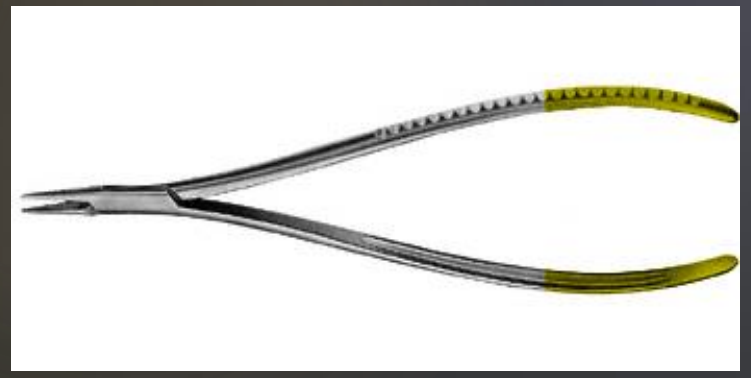
- Hegar-Mayo



- Mathieu

Special needle holders

- Palatinal needle holder
- Micro needle holder
- Needle holders without a lock



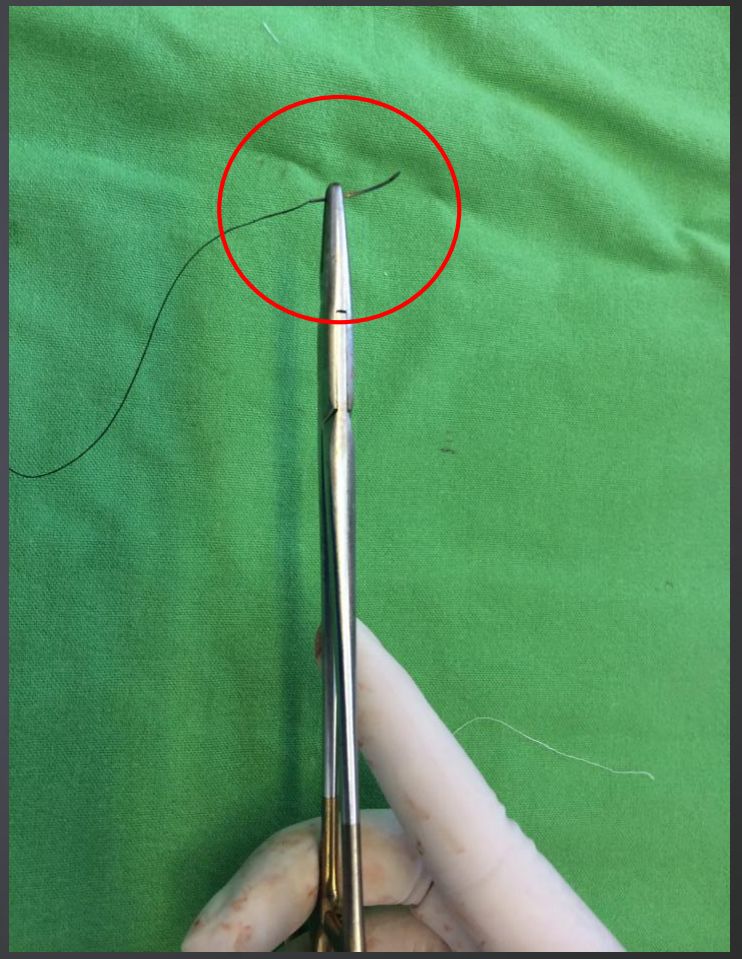
Principles of suturing

- Use suture needle of suitable shape and size
- Use suture material that is of suitable type and size for the tissue being sutured
- Good bite (2-3 mm from the free edge of the soft tissue)
- Sutures should **NOT** be placed under tension
- Knots should be tied **2-3 mm** away from the incision line
- Suture material is cut **4-5 mm** away from the knot
- Superficial sutures should be removed **5-7 days** after (exception: sinus closure) surgery to prevent infection / foreign body reaction

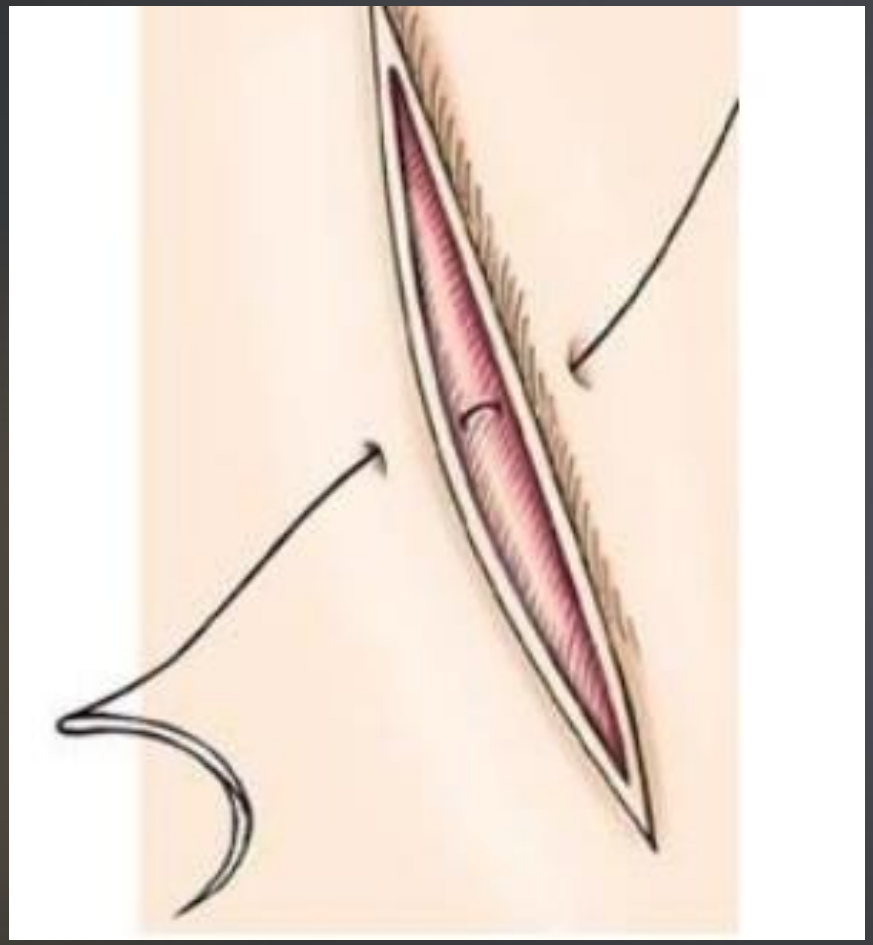
Advantages of suturing (closure)

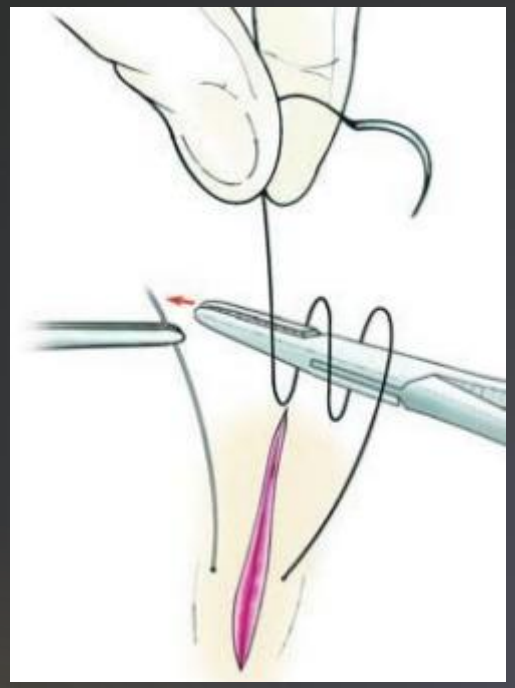
- Promotes healing
- Prevents complications
  - INFECTION
  - HAEMORRHAGE
  - TISSUE NECROSIS
- Preserve the normal contur and shape of tissues

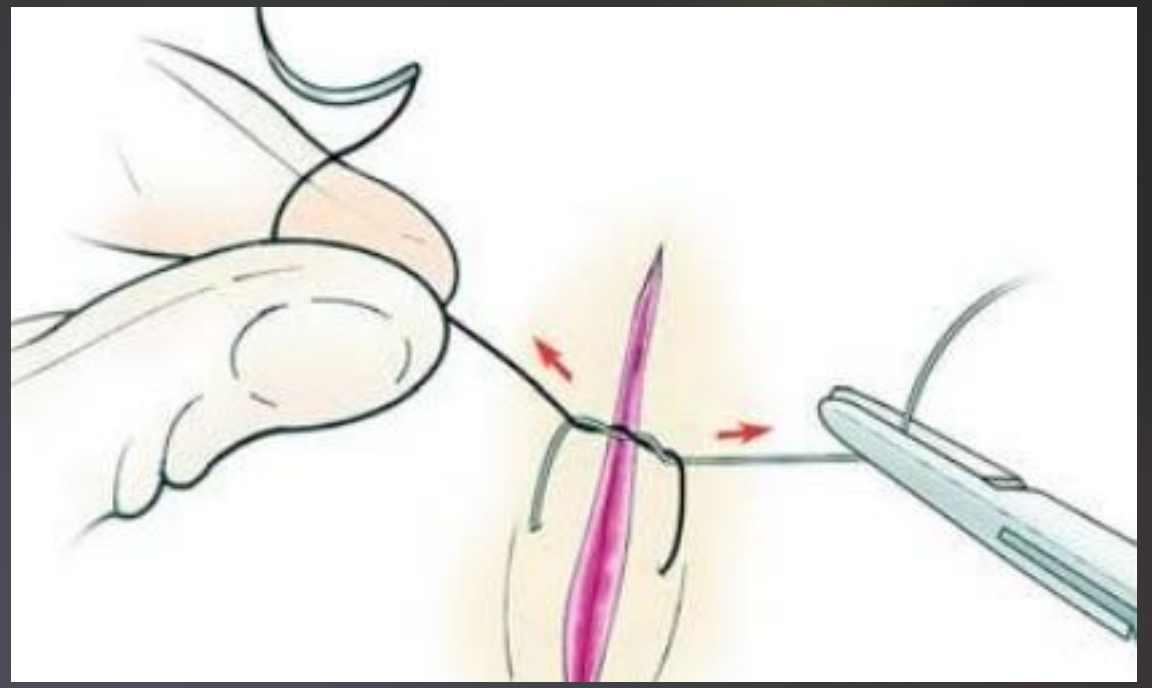
Grasping the needle

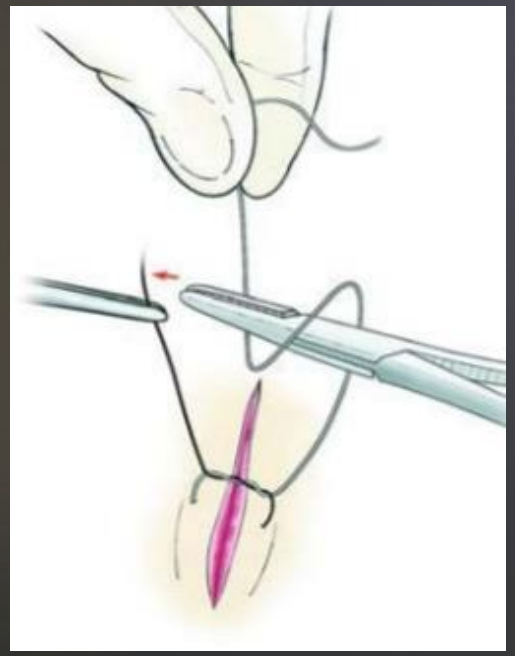


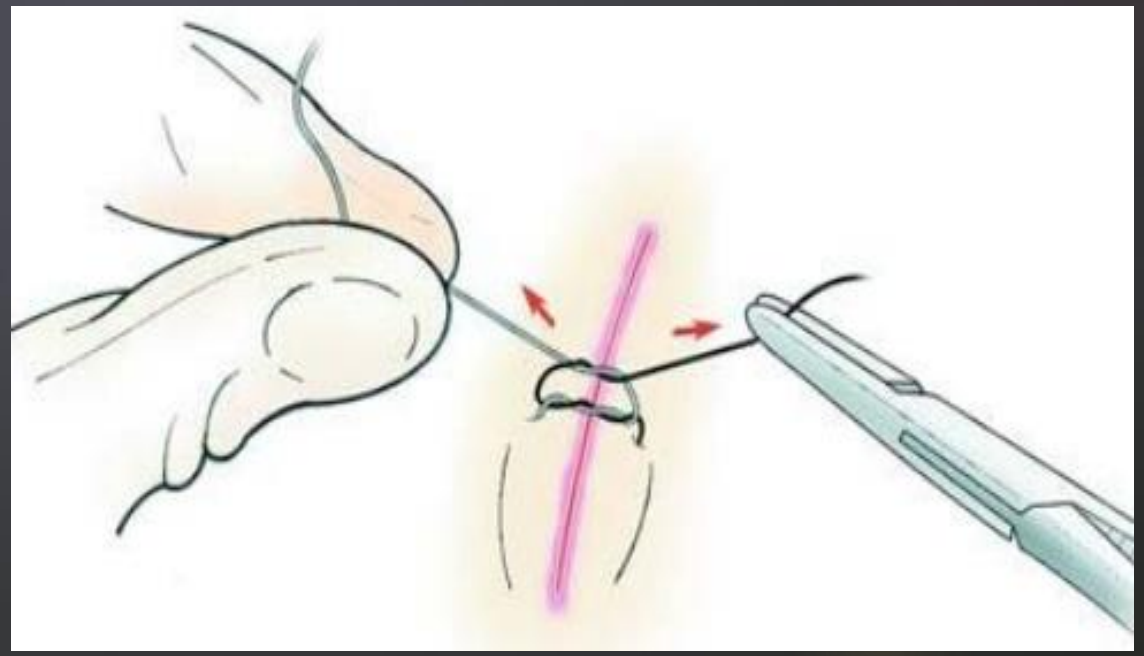
HOW TO MAKE A **KNOT**?





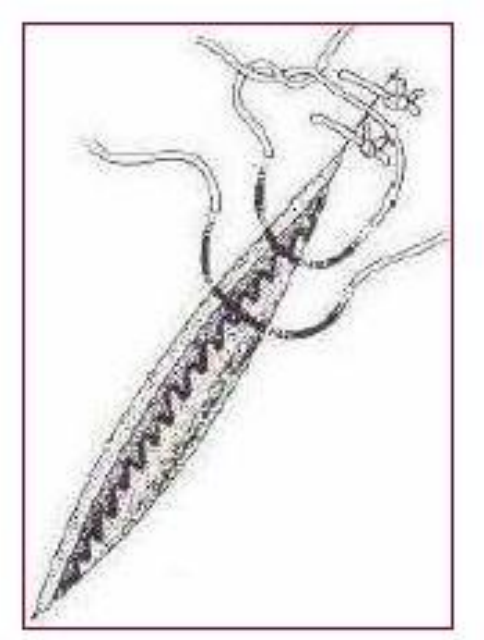


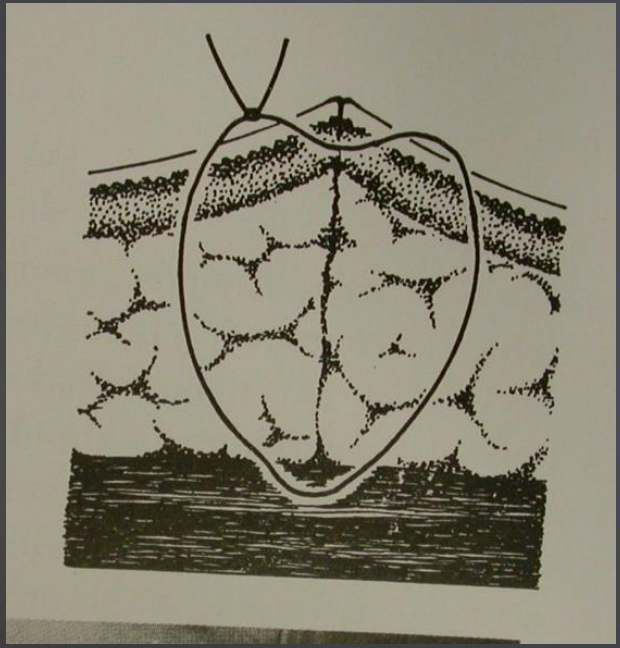




Suture techniques 1.

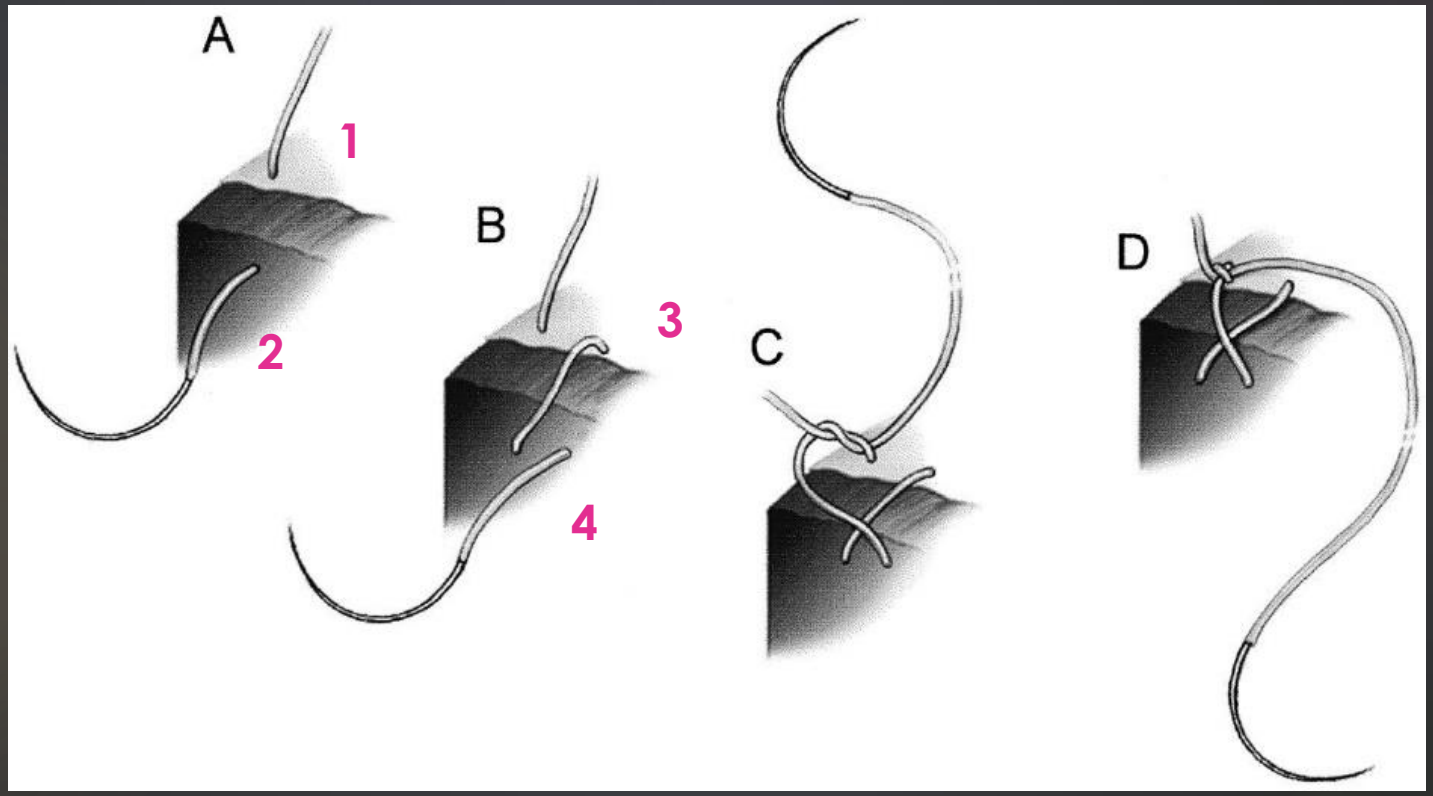
Single interrupted suture





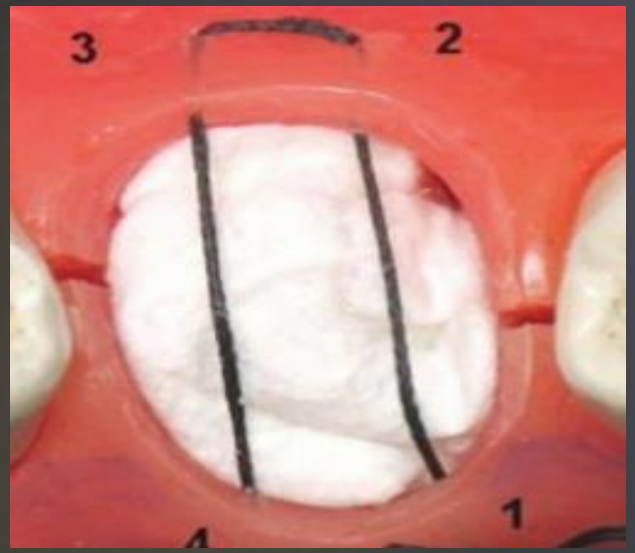
Suture techniques 2.

Figure 8 suture (Z-stitch, crossed matrass suture)



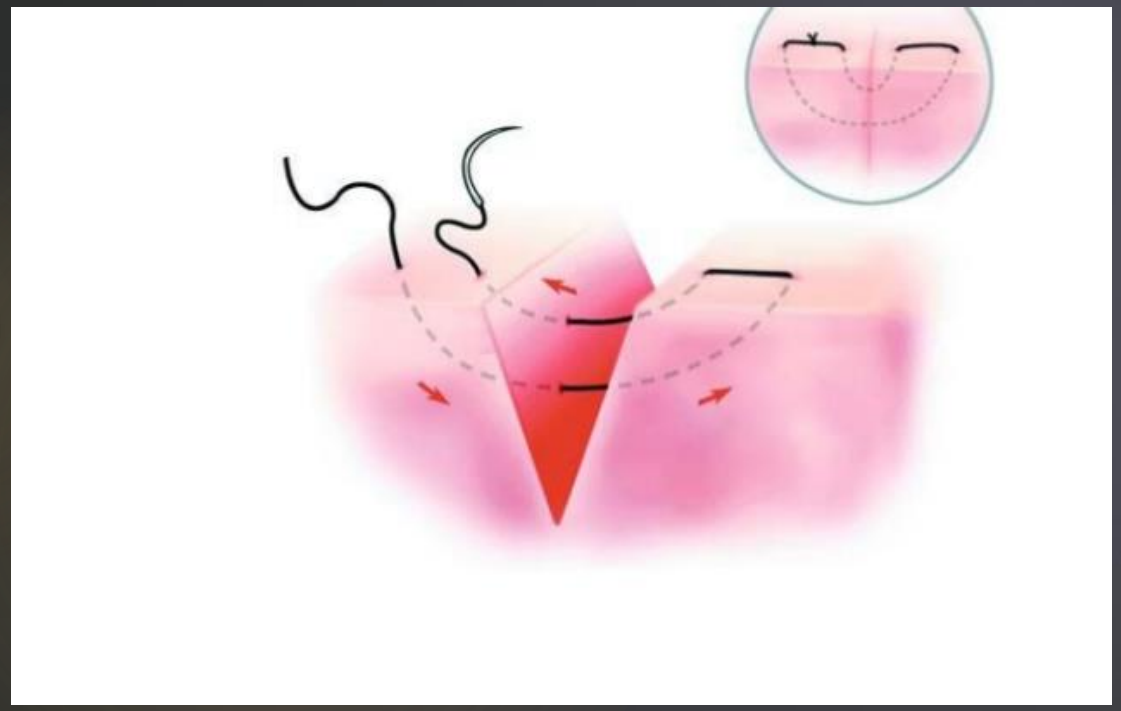
Suture techniques 3.

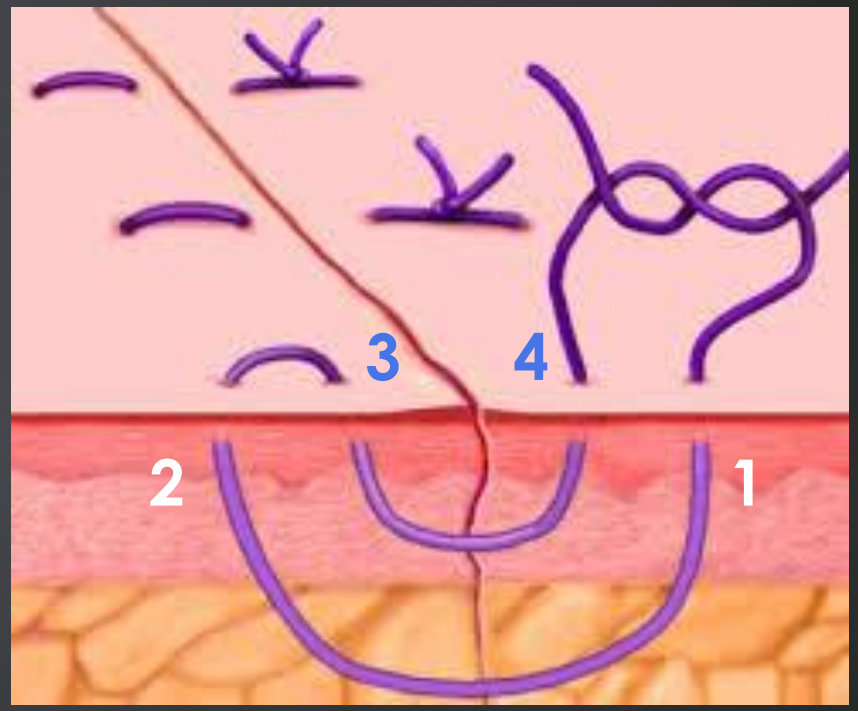
Horizontal matrass suture



Suture techniques 4.

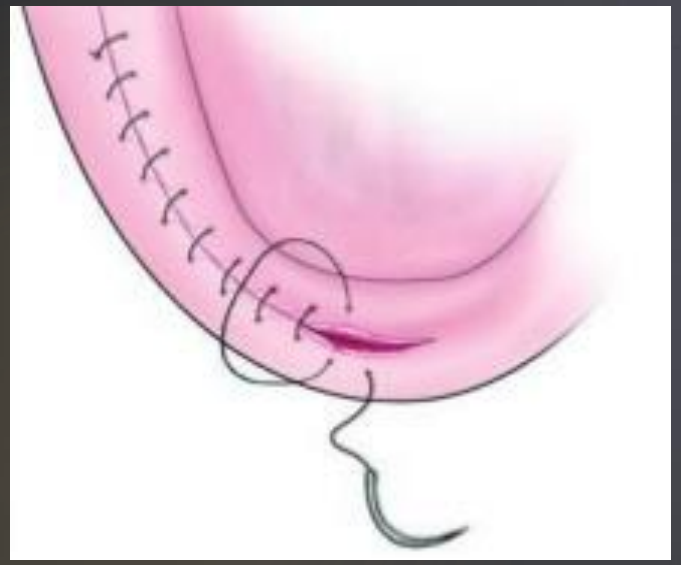
Vertical matrass stitch (Donáti)





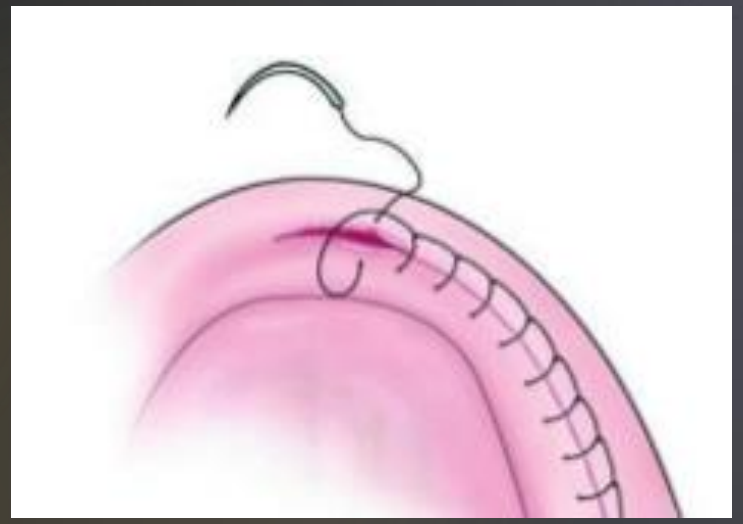
Suture techniques 5.

Continuous sutures



Suture techniques 5.

Continuous interlocking sutures



Thank you for attention!