



Surgery on vessels and nerves

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Vascular (arterial) injury has two main consequences:

1. Haemorrhage

2. Ischaemia.

An Czech surgeon sed: "Bloody vascular trauma - it's either bleeding too much or it's not bleeding enough".

Probable arterial injuries associated with fractures or dislocations

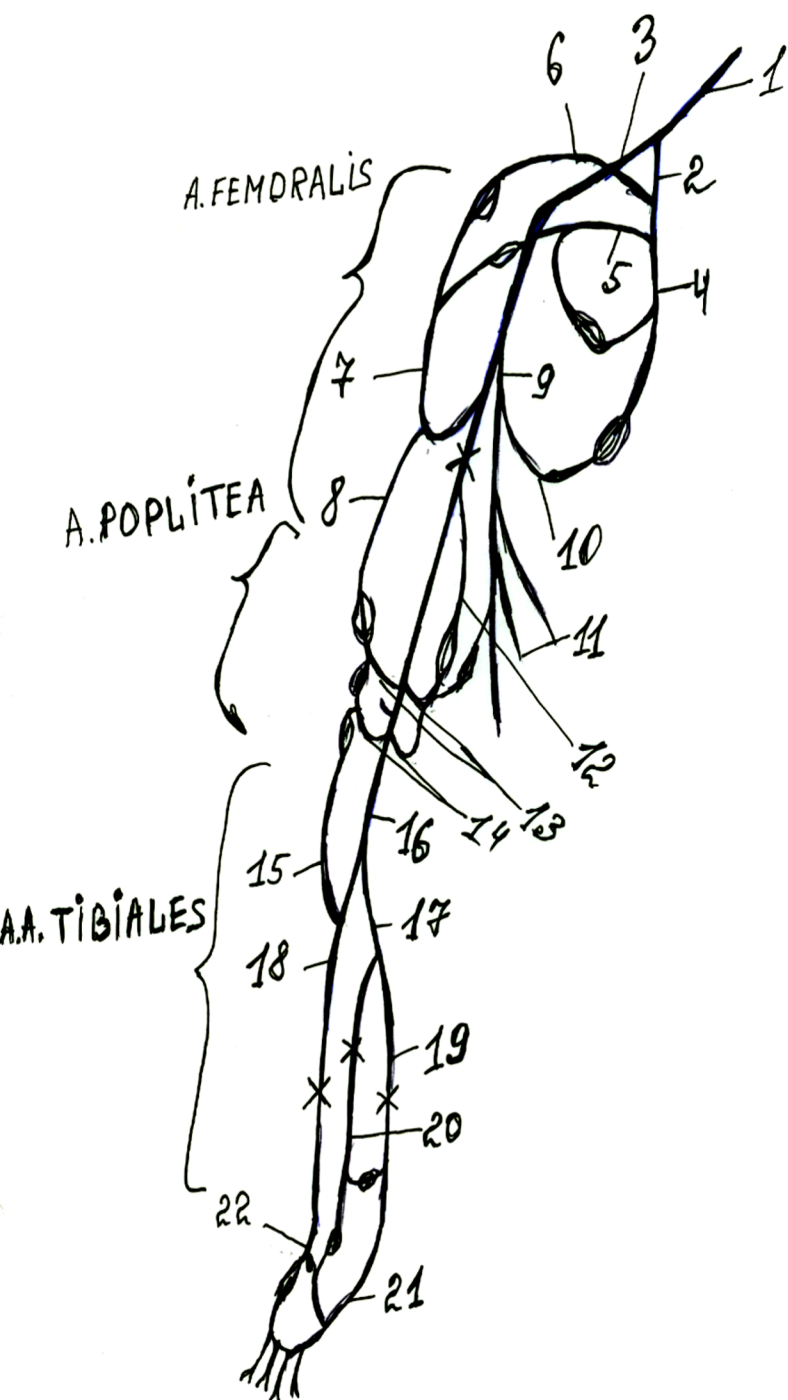
Clavicle fracture	subclavian artery/vein/br. plexus
Shoulder fr./dislocation	axillary artery/vein/br. Plexus
Humerus fracture	deep brachial artery/n.radialis
Supracondylar humerus fr	brachial artery
Elbow dislocation	brachial artery
Pelvic fracture	gluteal arteries
Femoral shaft fx	femoral artery
Distal femur fracture	popliteal artery
Knee dislocation	popliteal artery
Tibial shaft fracture	tibial arteries

Consequences of vascular injury

- Blood loss
- Ischemia
- Compartment syndrome
- Tissue necrosis
- Amputation
- Death

Prognostic factors depends of:

- Level and type of vascular injury
- Collateral circulation
- Tissue damage
- Ischemia time
- Patient factors
- Medical conditions (equipment, personnel)



1. A. iliaca communis;
2. A. iliaca interna;
3. A. iliaca externa;
4. A. obturatoria;
5. A. glutea inferior;
6. a. glutea superior;
7. R. ascendens a. circumflexa femoris lateralis;
8. R. descendens a. circumflexa femoris lateralis;
9. A. profunda femoris;
10. A. circumflexa femoris medialis;
11. rr. Perforantes a. profunda femoris;
12. A. genus descendens;
13. Aa. Genus superior medialis et lateralis;
14. Aa. Genus inferior medialis et lateralis;
15. A. recurents tibialis anterior;
16. A. poplitea;
17. A. tibialis posterior;
18. A. tibialis anterior;
19. A. tibialis posterior;
20. A. tibialis anterior;
21. A. plantaris;
22. A. dorsalis pedis.

Unrecognised and untreated ischaemia can lead to:

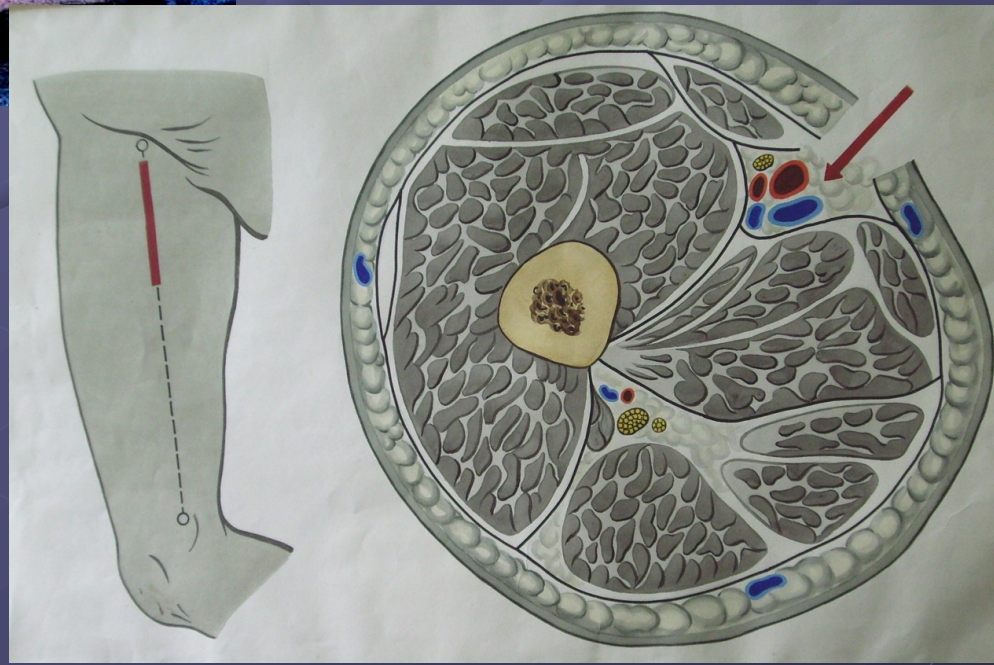
1. limb loss,
2. stroke,
3. bowel necrosis
4. multiple organ failure.

Pulse Examination

Lower limb	Upper limb
Femoral A	Subclavian artery
Popliteal A	Axillary artery
Dorsalis pedis A	Brachial artery
Posterior tibial A	Radial artery

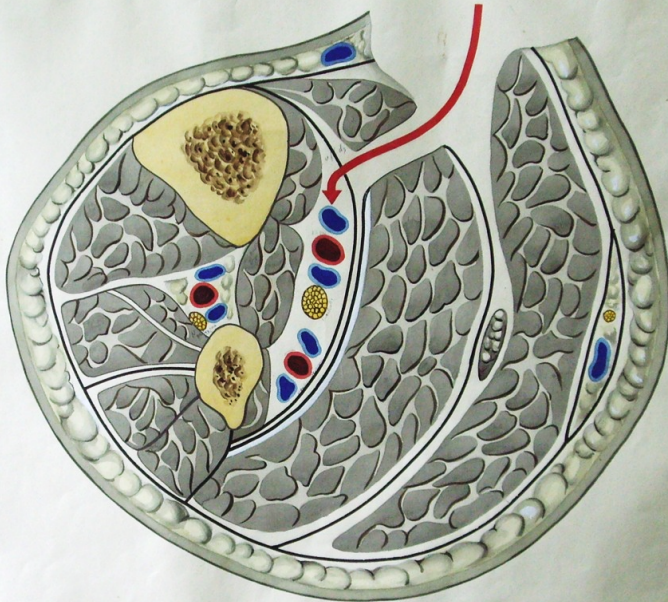
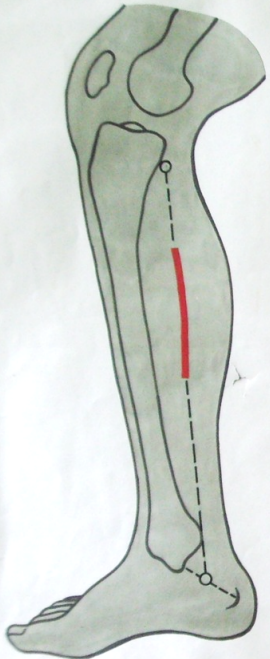
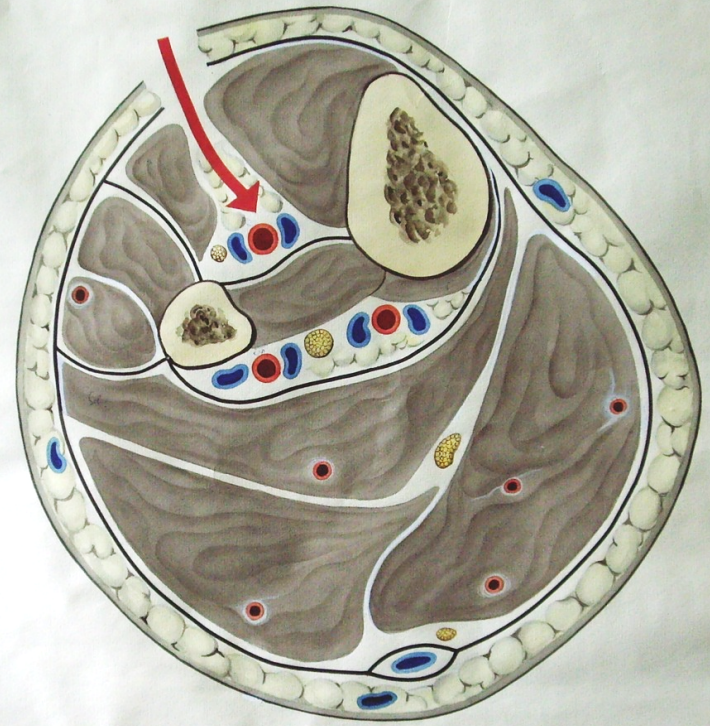
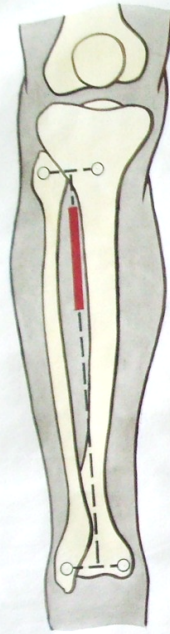
Figure 3.1

Femoral Artery



Popliteal A





Dorsalis pedis A

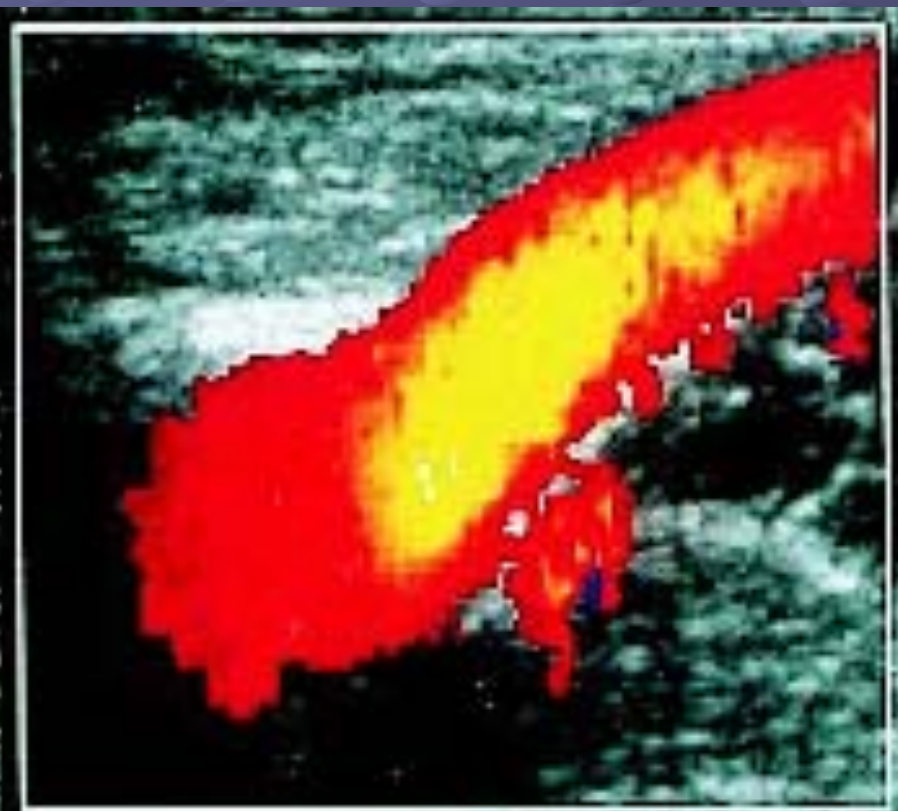
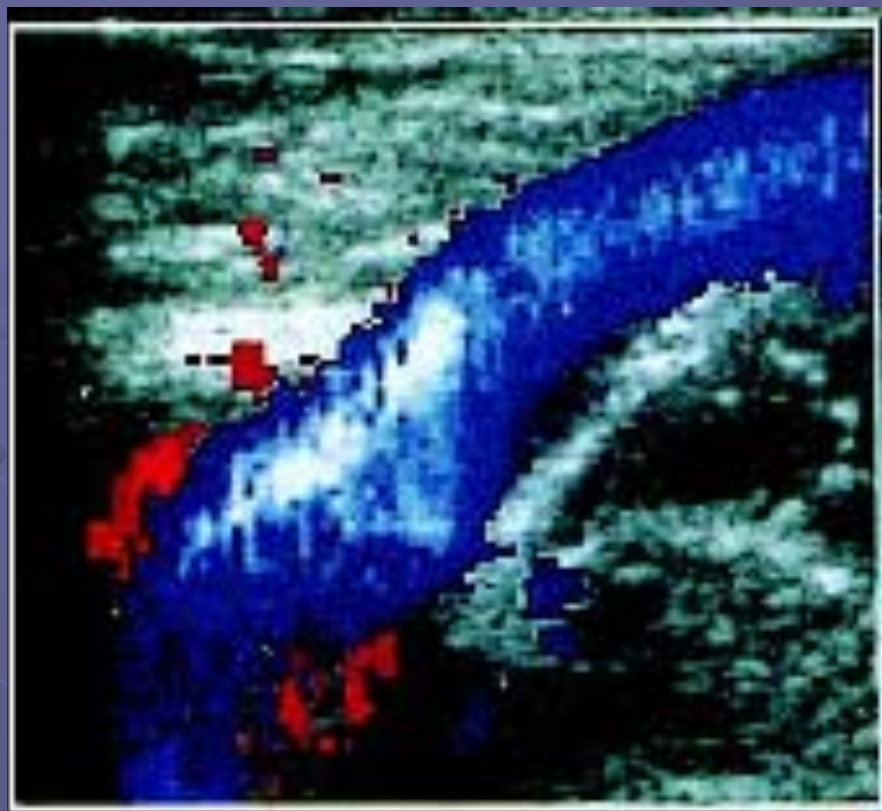


Post tibial A



Examination

- Doppler
- MRA
- CT
- Angiografy



Types of surgery

- Arterial:
 - Endarterectomy
 - Arterial ligature
 - Bypass graft
 - Angioplasty

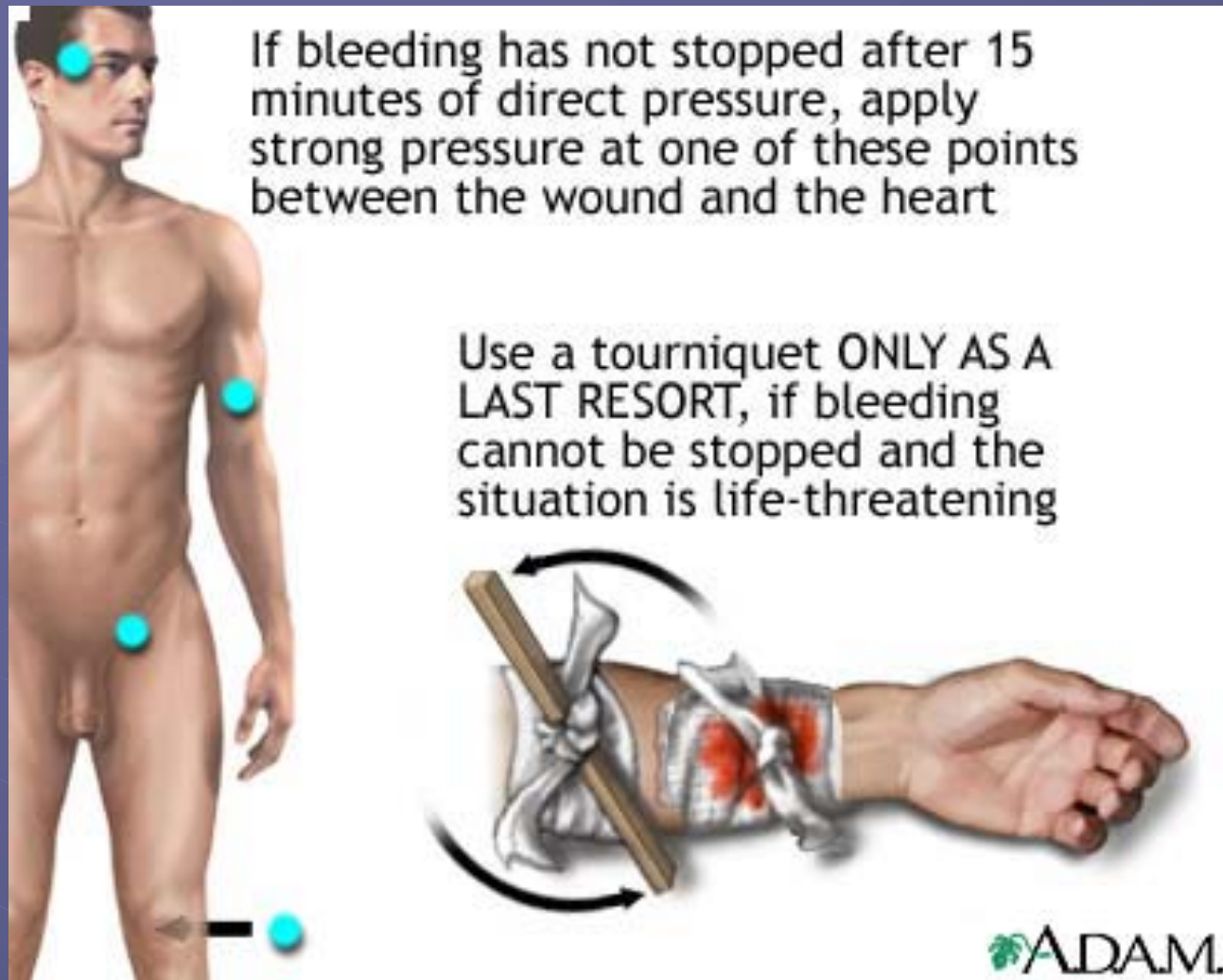
● The priorities of vascular injury are haemostasis and normal circulation restoration.

● never risk life to save a limb!!!

The bleeding stoppage

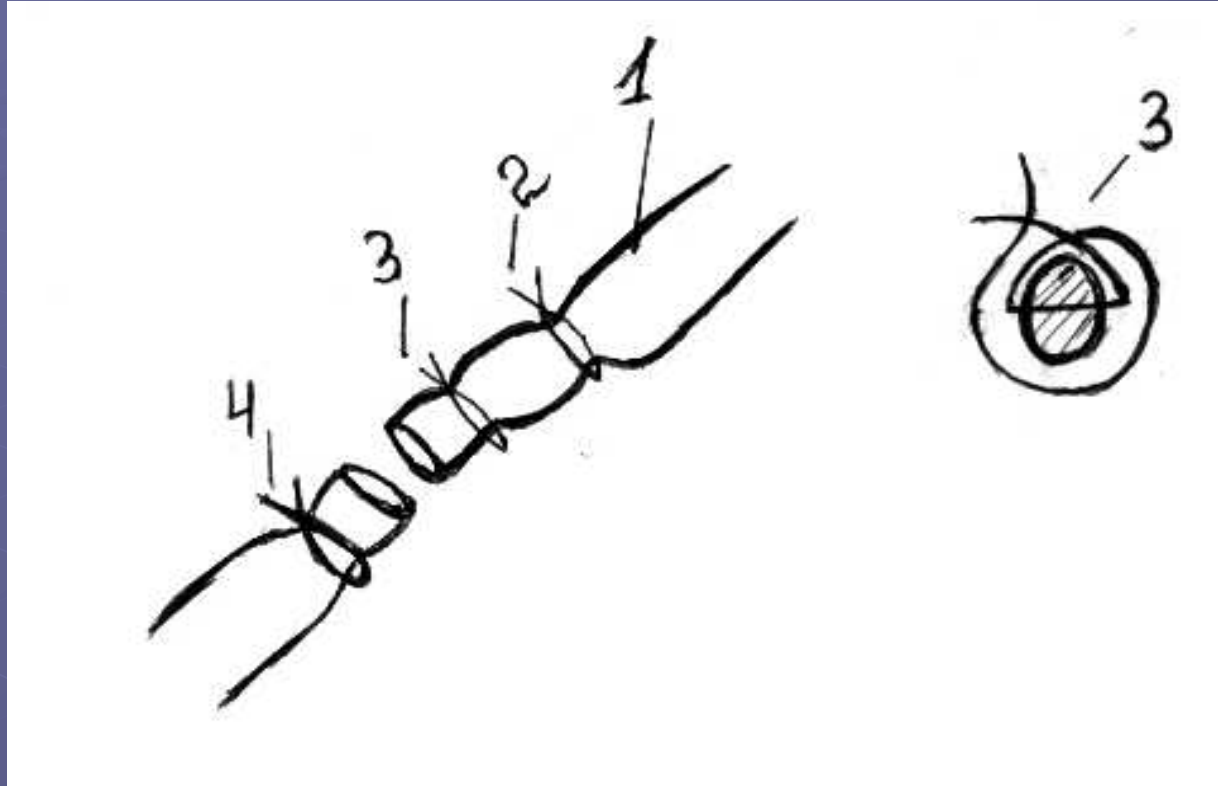
- Immediate control is usually achievable by **direct pressure over the site of injury**. It is better one individual to **manually** compress the site of haemorrhage.
- **Tourniquet** are an effective way of stopping bleeding from an extremity.

- The **manually** or **tourniquet** compression higher than the place of injuries:
 - **On upper limb one can press (squeeze) a main artery if necessary :**
 - (manually) **subclavian artery** on first rib;
 - (manually or tourniquet) **brachial artery** the site of the arm at humerus bone just above the elbow and just below the armpit Squeeze the main artery in these areas against the bone
 - **On lower limb one can press :**
 - (manually) **the femoral artery** on superior ramus of pubis bone,
 - (tourniquet) at the **middle site of femoral bone**
 - (manually) **popliteal artery** in the popliteal fossa just behind the knee
- Where haemorrhage is welling up from a deep knife or gunshot track, haemostasis may be temporarily achieved **by passing a urinary catheter into the track as far as possible, inflating the balloon**



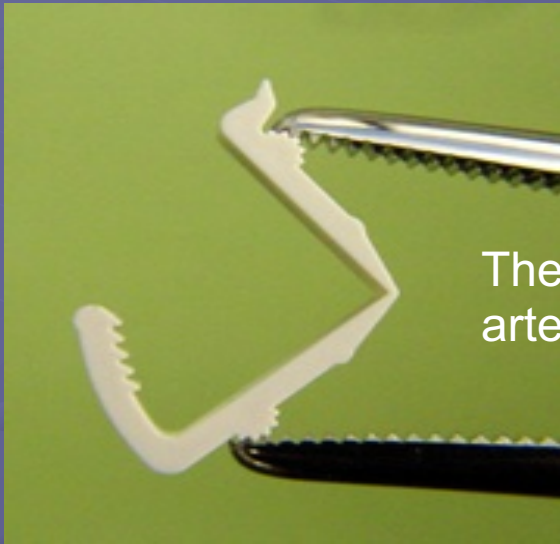
Blind clamping with a **haemostatic forceps** in the depths of a wound is dangerous and can be made only in the surgery room

Ligature technique on the arterial big vessel in the wound

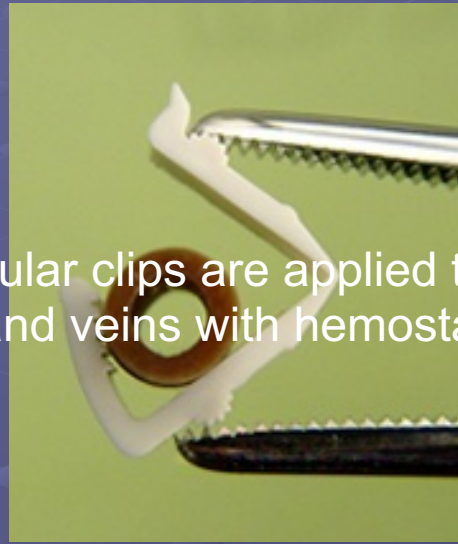


1. Proximal end of blood vessel,
2. Proximale ligature
3. Distale ligature transmurale,
4. ligature on distal end of the vessel

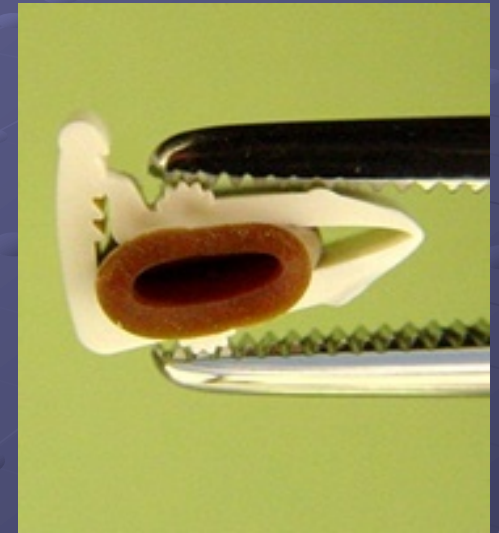
The vascular clips are applied to the arteries and veins with hemostats



Step 1.
Insert the opened
clip into the jaws
of the hemostats



Step 2.
Position the blood
vessel into the clip using
a scooping motion

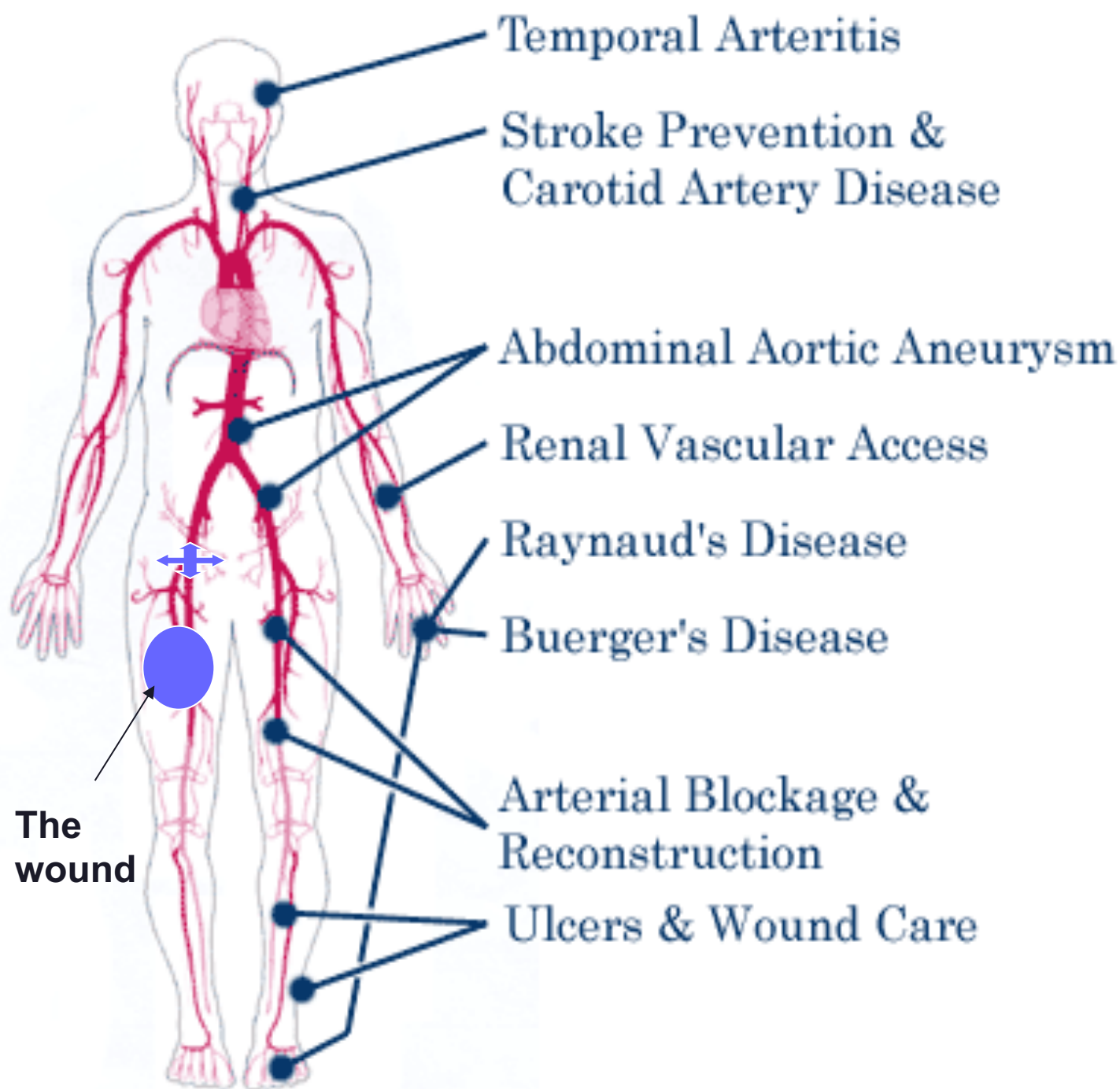


Step 3.
Close clip tightly
over blood vessel,
one each side of the
incision

Ligature technique on the arterial big vessel proximally from the injury site

● Indications:

- Purulent wounds, gangrena
- When it's impossible to find the end of the vessel (a. glutea superioris – on ligature on a. iliaca interna; a. lingualis – ligature on external carotid artery.)



**Ligature
technique
on the
arterial
big
vessel
proximall
y from
the injury
site**

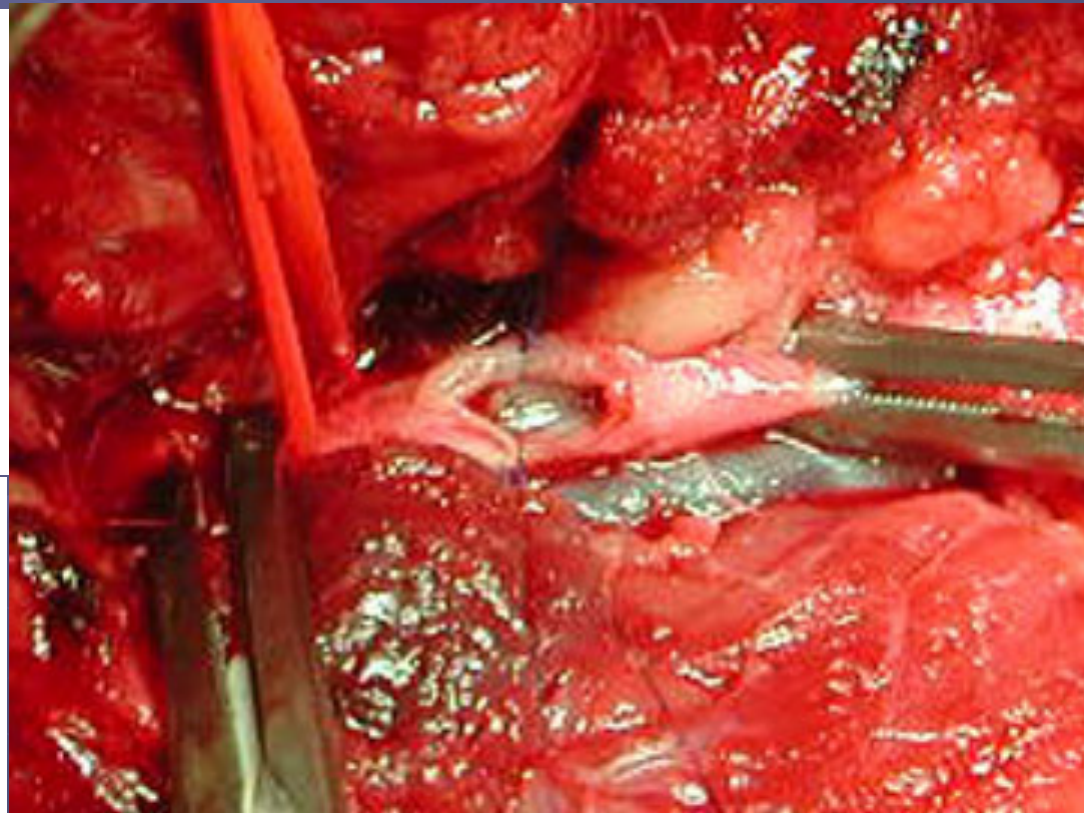
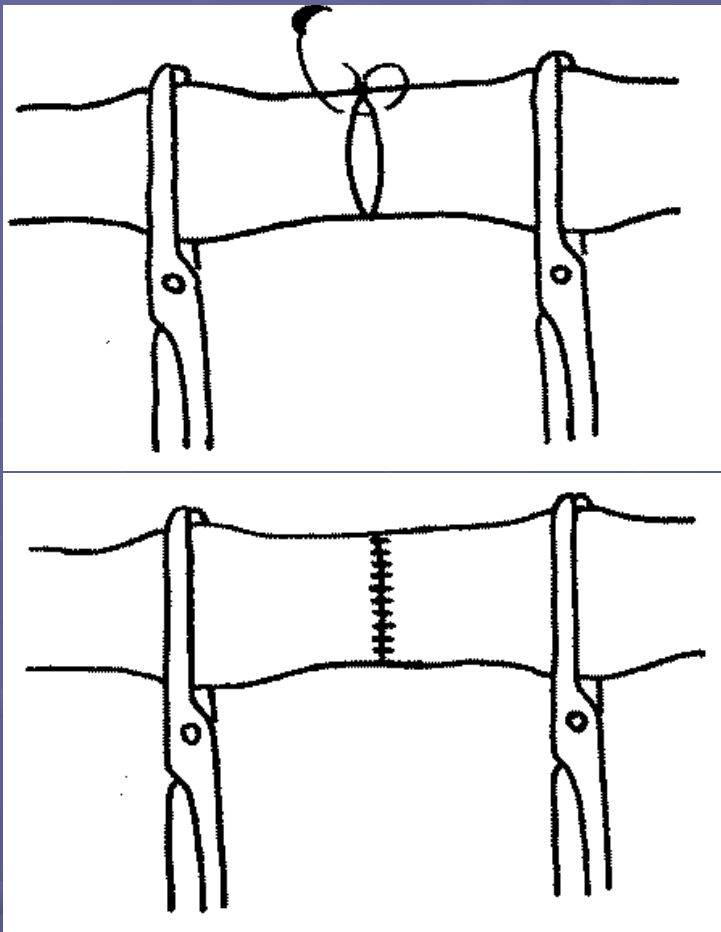
Technical principles on vascular sutures

1. Aim for a smooth flow by a. Avoiding loose flaps
2. Avoiding both intrinsic and **extrinsic constriction**
3. Avoid narrowing at anastomoses
4. Handle all arteries and grafts with care
5. Strict asepsis
6. Peroperative anticoagulation

Vascular suture

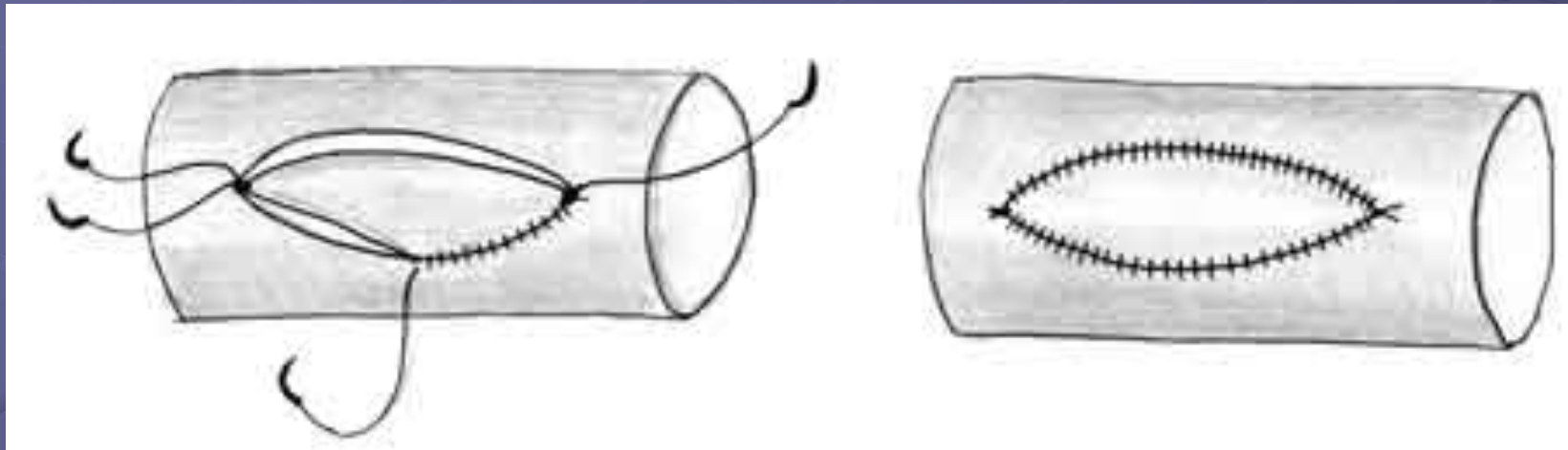
- Manual vascular sutures
- Mechanical vascular sutures

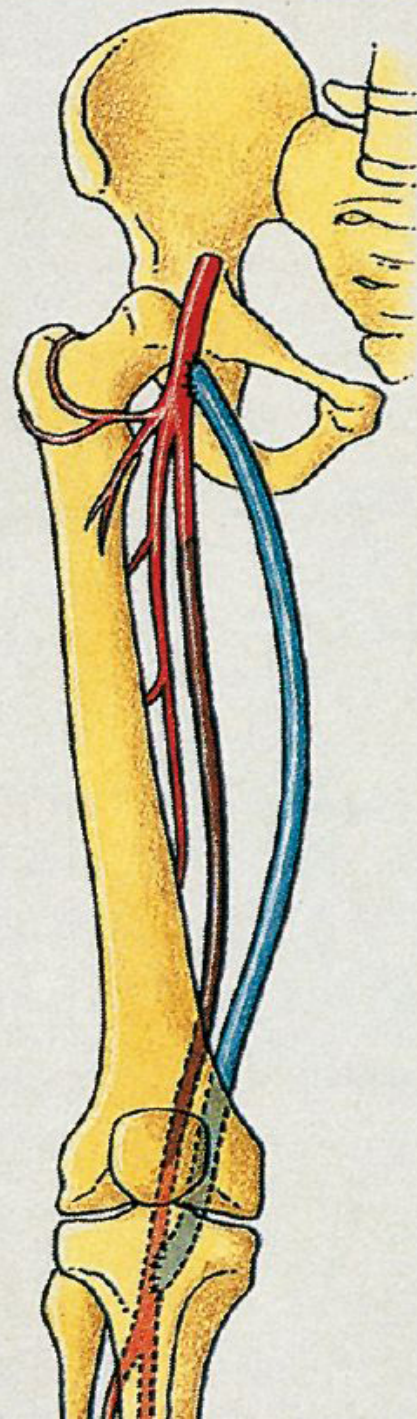
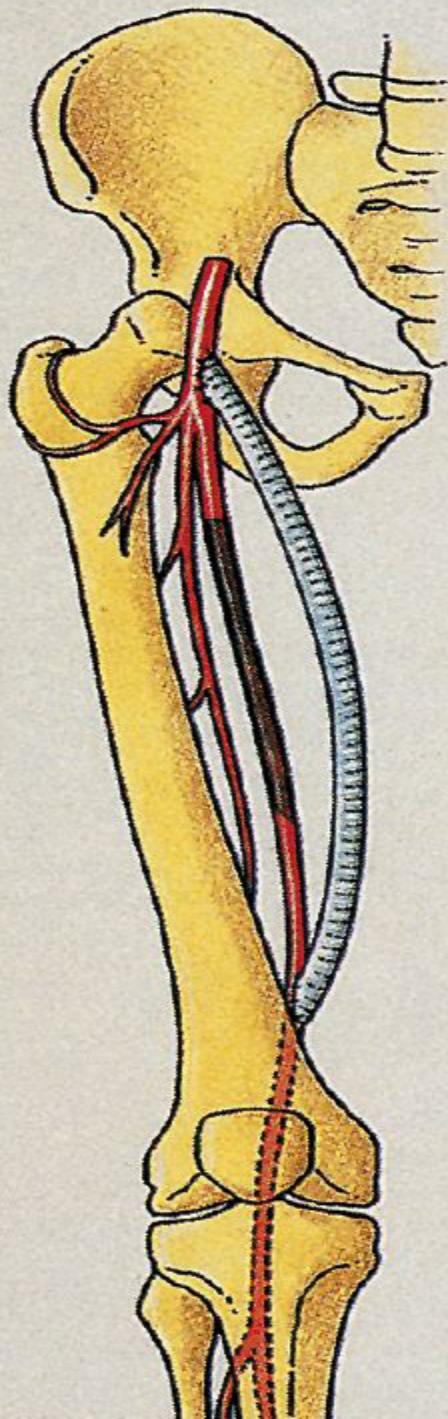
Small, clean, transverse wounds to vessels that involve only part of the circumference can be repaired with a direct suture technique

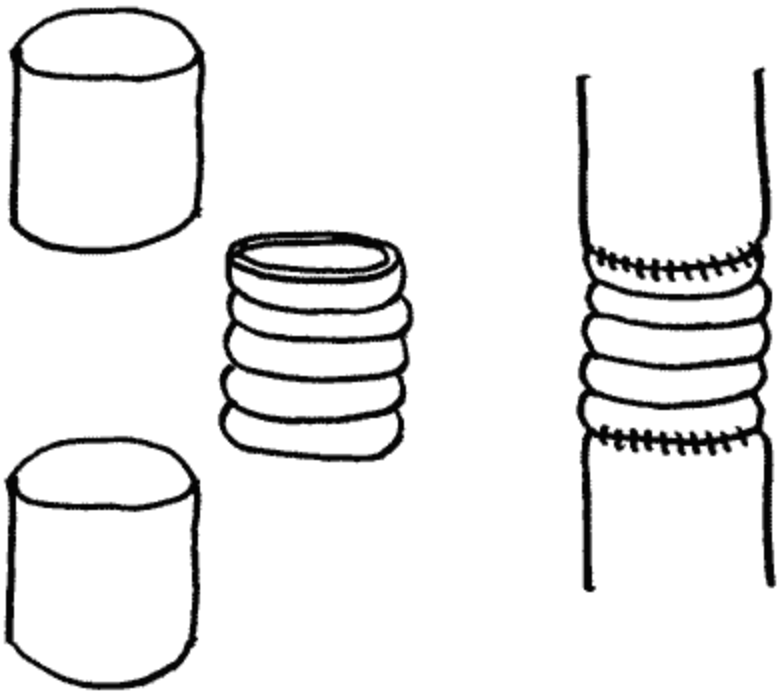


To avoid the narrowing of the vessels some times is necessary to use the:

- Vein patch or Synthetic patch







Synthetic angioplasty with Dacron

- Very good replacement for large vessels (> 10 mm)

Problems

- Tend to buckle across joints
- False aneurysms at anastomoses
- Thick intimal deposition (2-4 mm)
- Infection of implanted foreign material b.

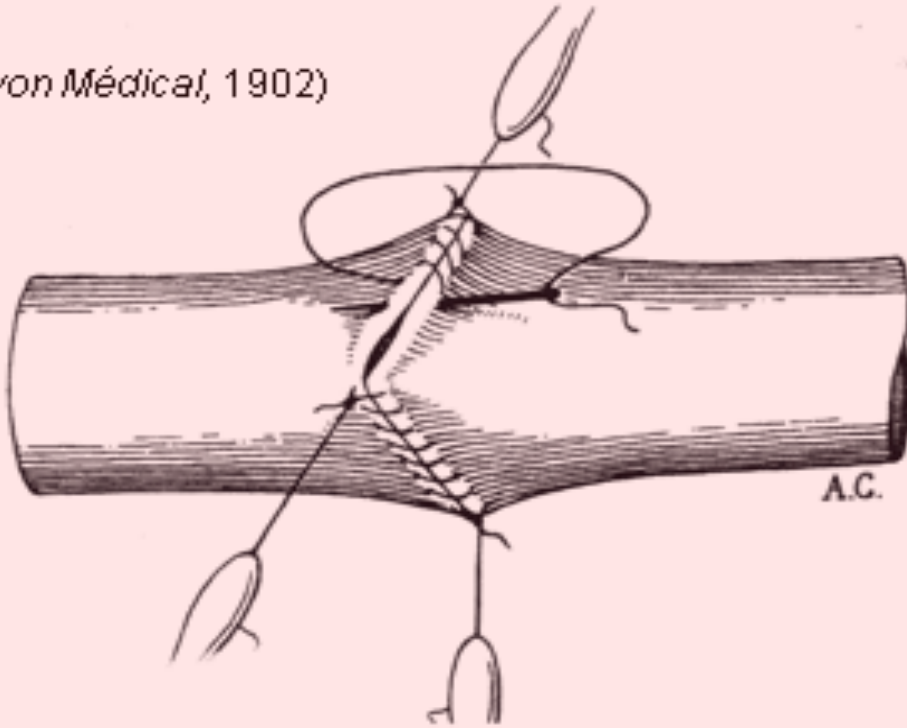
PTFE (Goretex)

- Useful for smaller arteries (e.g. superficial femoral)
- Easy to suture and requires no pre-clotting

Problems

- High 3-year failure rate ($> 30\%$) compared with vein infection
- Tendency to kink

(*Lyon Médical*, 1902)

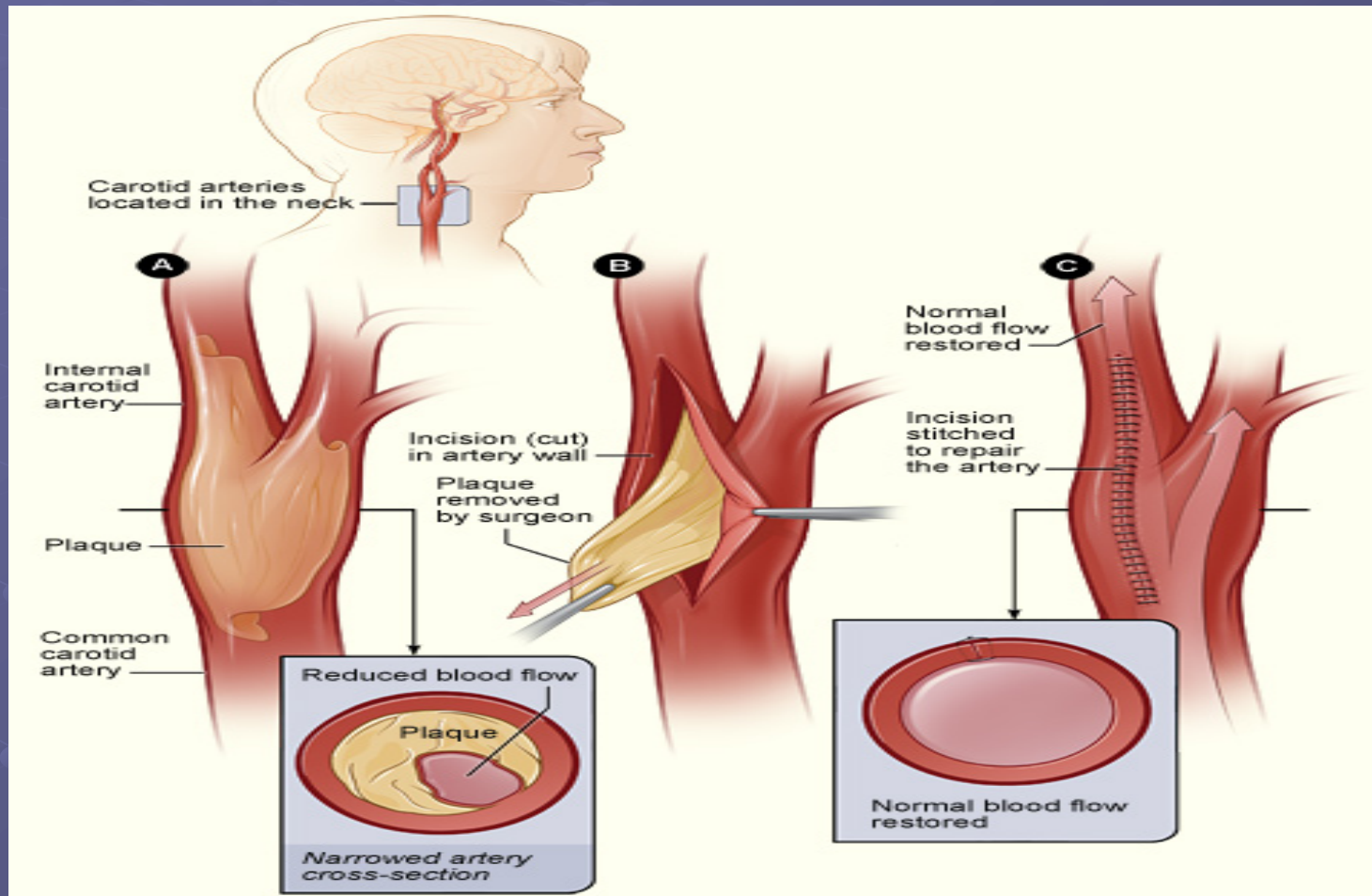


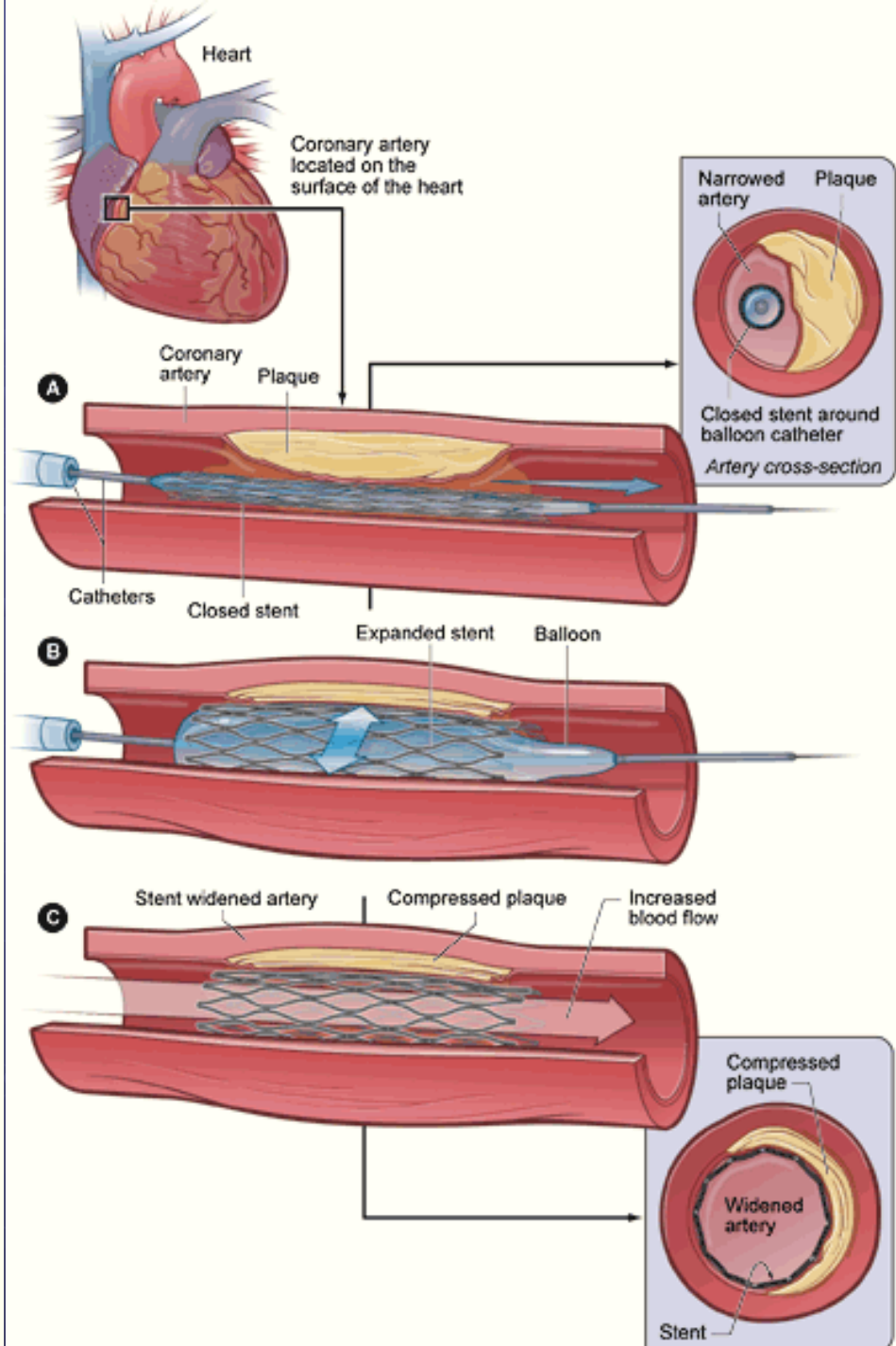
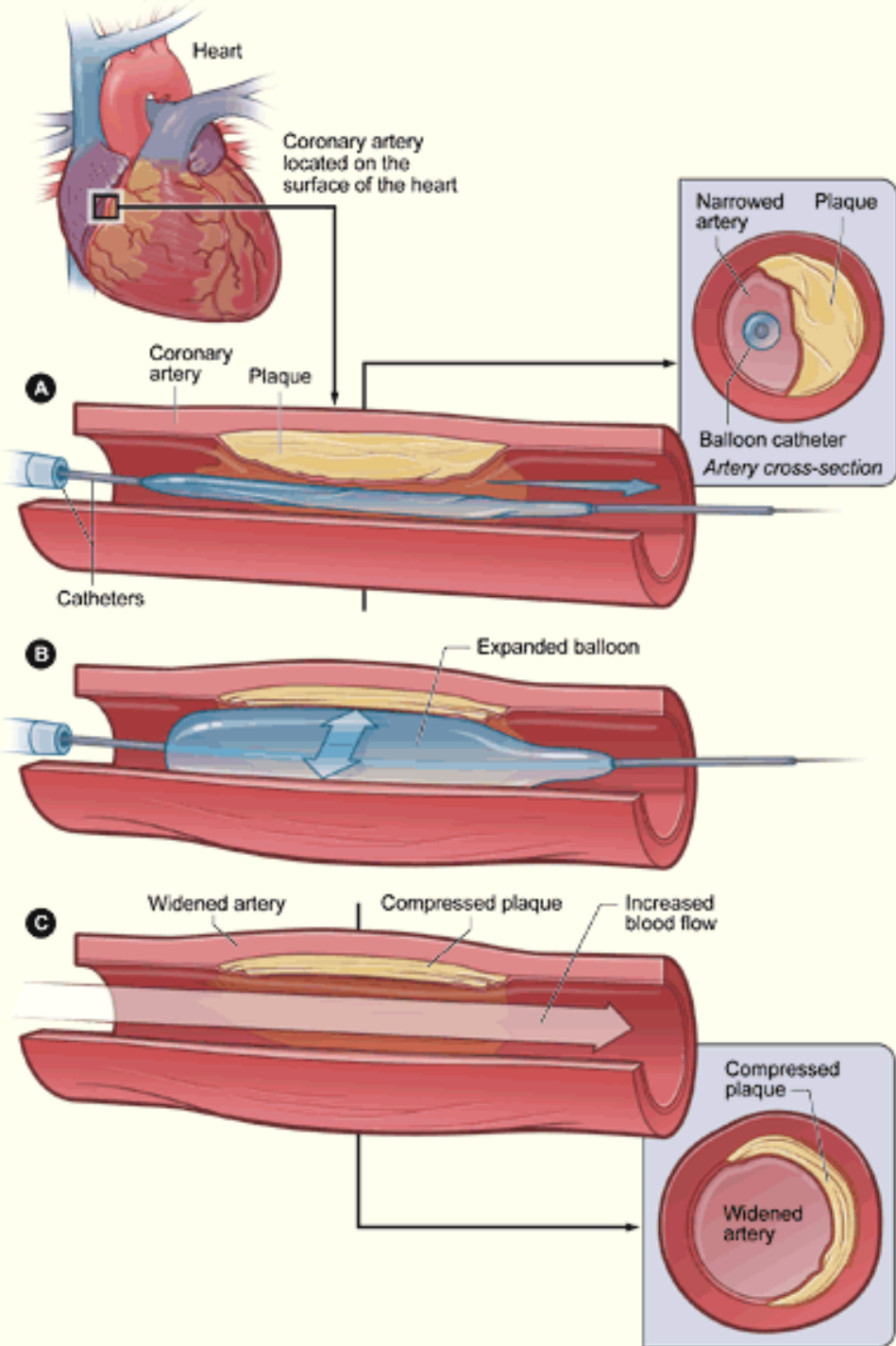
Técnica de anastomosis vascular, según Carrel

Carrel's vascular suture
description:
End-to-end anastomosis
of severed vessels with
triple-threaded sutures.

Endarterectomy (Atherectomy): is a procedure to remove plaque from arteries. Plaque is the buildup of fat, cholesterol and other substances in an artery's inner lining. **Only for larger arteries which do not cross joints (aorta, iliacs and carotids arteries)**

Carotid Endarterectomy





Sympathectomy

- Surgical
- Chemical

LUMBAR SYMPATHECTOMY:

Indications:

- Peripheral vascular disease like TAO.
- To promote healing of cutaneous ulcers.
- To change level of amputation and to make flaps to heal better after amputation.
- Causalgia of lower limb (it is common in upper limb).



Chemical sympathectomy:

It is done in lateral position using a long spinal needle under local anaesthesia. Position is confirmed by injecting dye under fluoroscopy. Later 5 ml of *phenol in water* or absolute alcohol is injected lateral to the vertebral bodies of fourth and second lumbar vertebrae. Care should be taken to see that the needle does not enter IVC or aorta.

Procedure is contraindicated in patients with *bleeding disorders* and in patients who are on *anticoagulants*.



Grafting

- By vein (best material, available from long saphenous or cephalic veins)
- Synthetic dacron (very good replacement for large vessels ($> 10\text{mm}$))
- RTFE

Internal Mammary Bypass Grafts

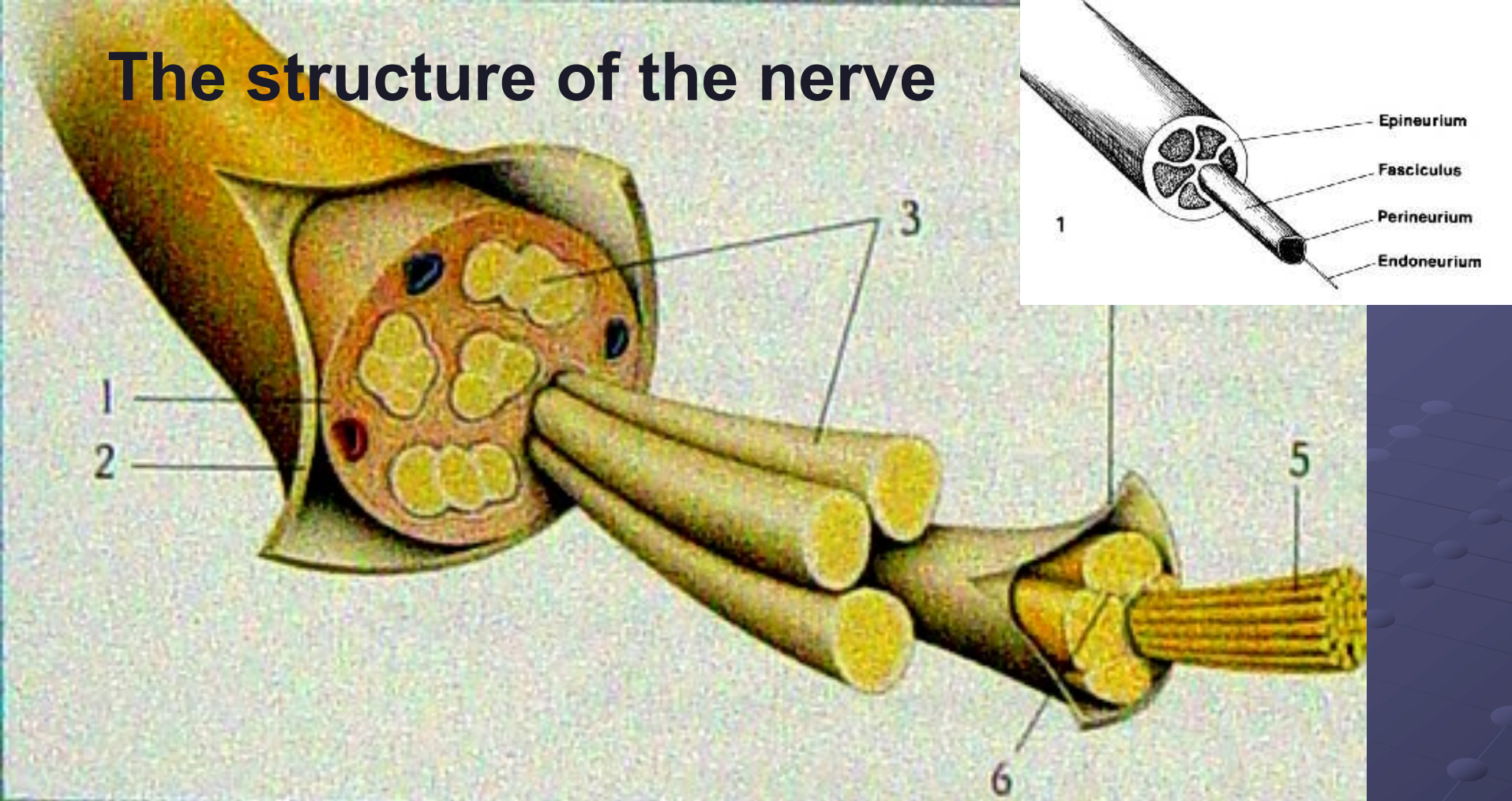
- In addition to standard using veins removed from the leg or artery the surgeon may also use one of the arteries that normally feeds the chest wall, the Internal Mammary Artery. With this approach the artery is dissected away from its normal position and rerouted to be attached to one of the coronary arteries. This avoids the need to utilize a vein graft.
- Traditionally a CABG is done by splitting the breastbone of the patient, exposing the entire heart to the surgeon's view. A new technique utilizing robotic arms and an internal camera is being pioneered at Penn State Hershey Medical Center.

Principles of management of nerve injury

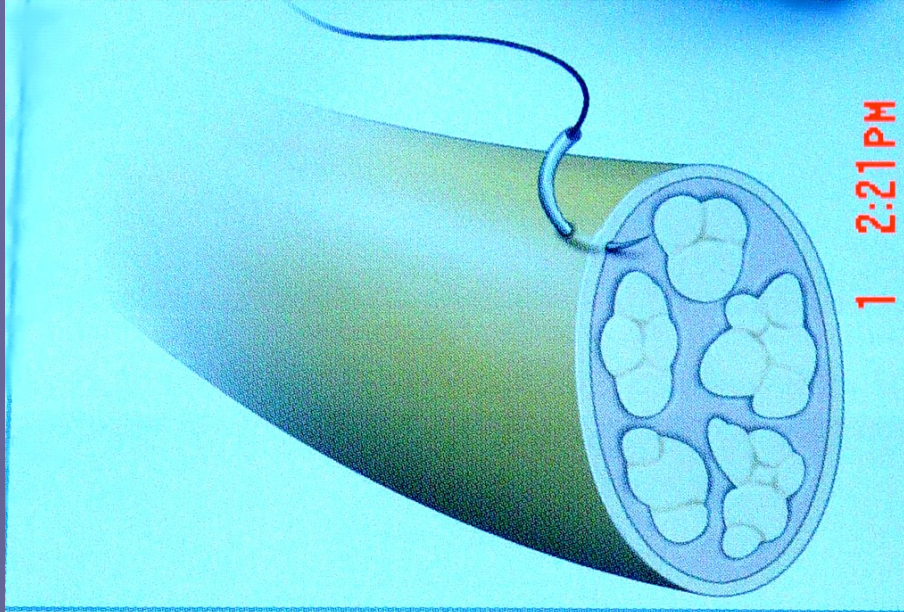
● Exploration needs:

- Avascular field (tourniquet)
- Available facilities for microsurgery
- Good light
- Adequate anesthesia
- Preserve all viable skin and all tissue around.

The structure of the nerve

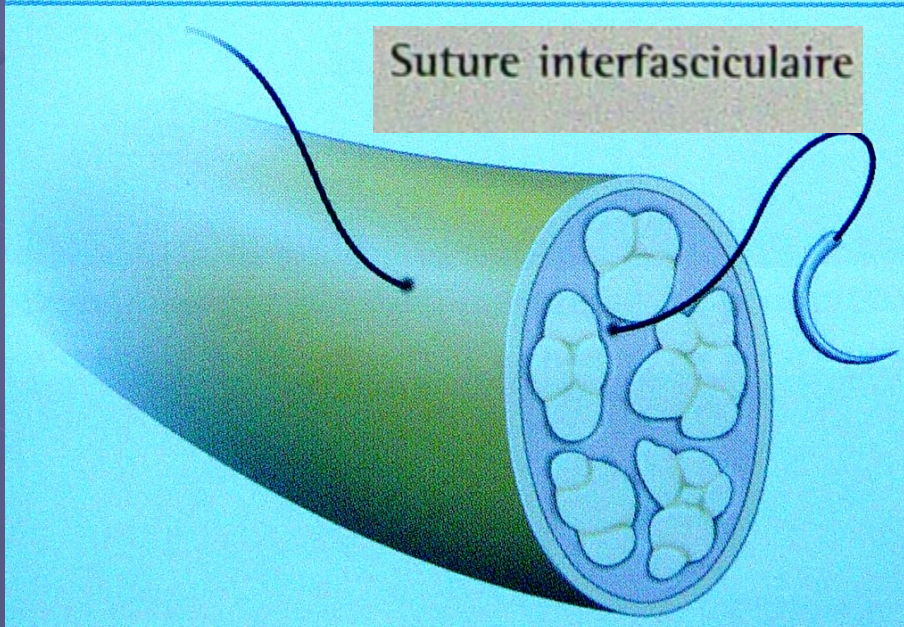


- 1 and 2) Epineurium;
- 3) Group of Fascicules;
- 4) perineurium;
- 5) Nervous fibers;
- 6) Endoneurium



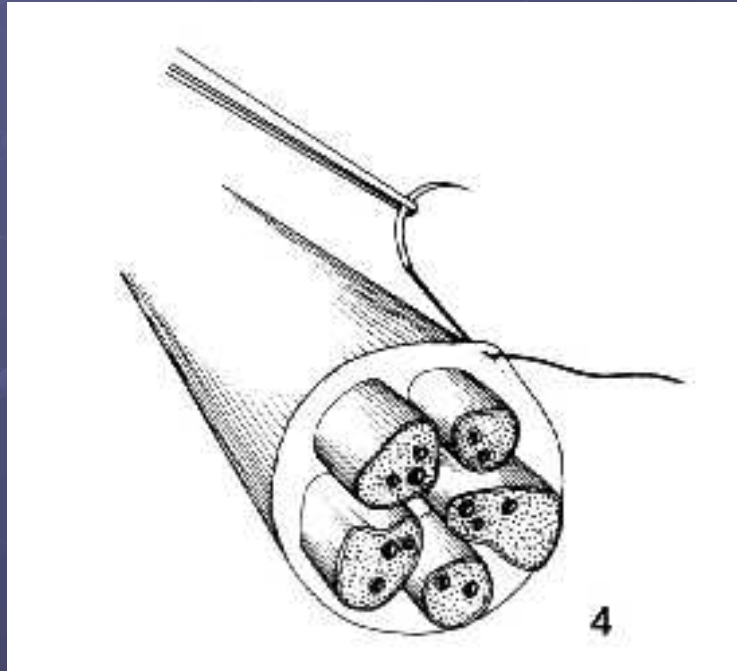
1 2:21 PM

Suture épineurale.



Suture interfasciculaire

In complete or incomplete nerve severance, repair by suture anastomosis is indicated. Primary suture should be attempted only in wounds that are clean, seen immediately caused by knife or razor, and devoid of adjacent tissue damage.

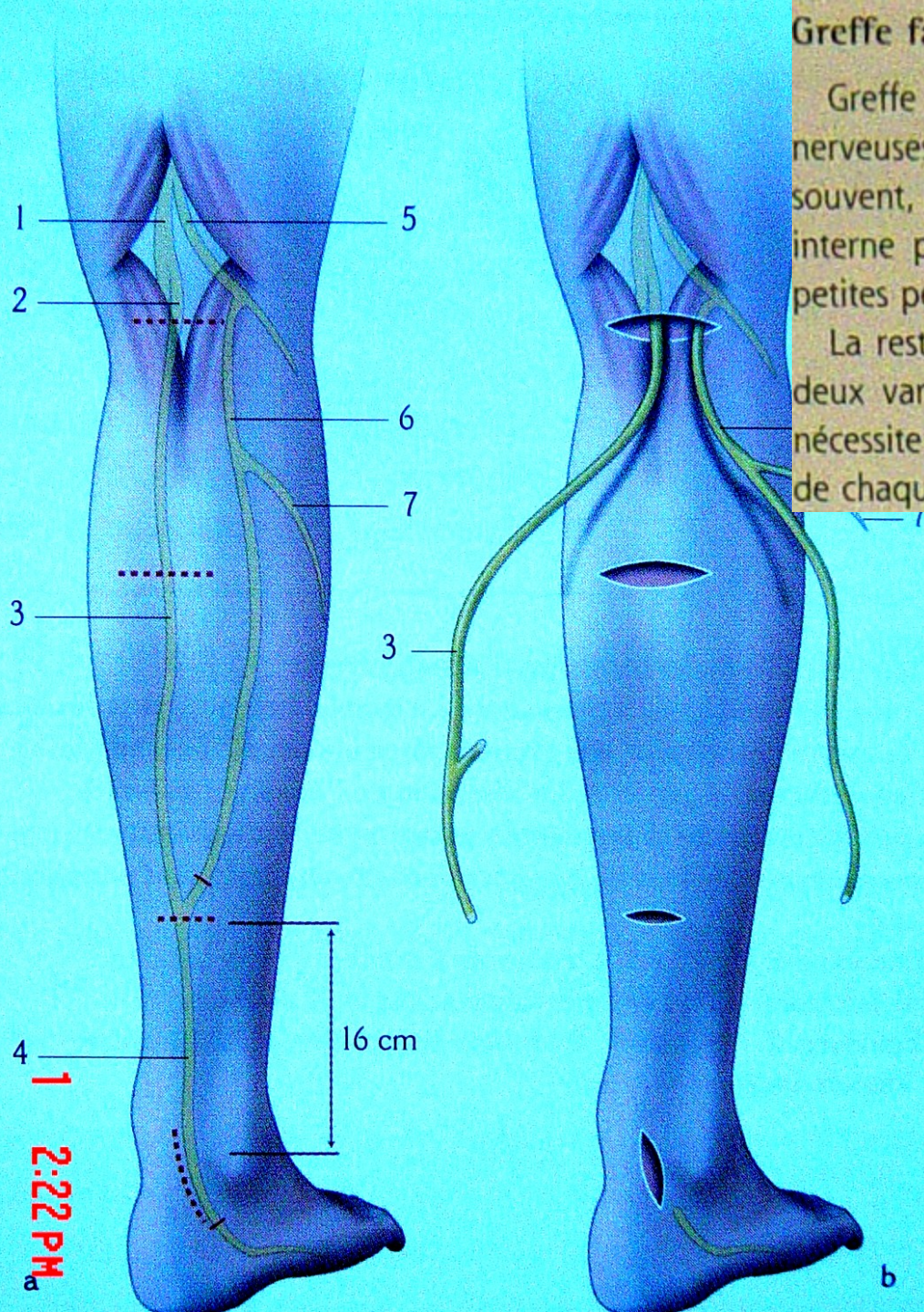


If removal of scarred ends leaves a gap between the nerve ends, length can be gained **by nerve transposition** by limitation on flexion or by bone shortening to close the nerve gap.

Greffe fasciculaire

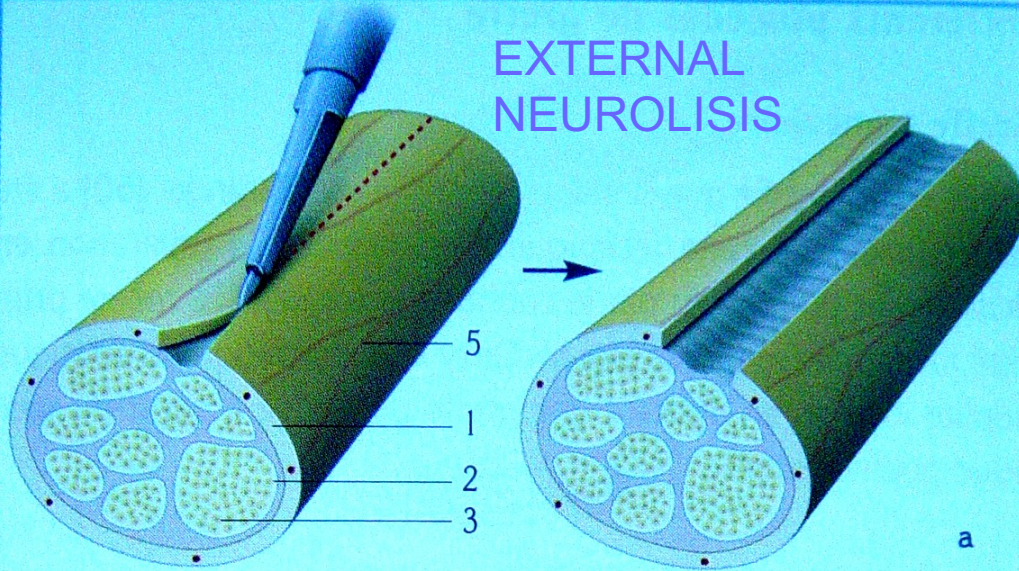
Greffe la plus utilisée pour réparer les pertes de substance nerveuses, elle nécessite le prélèvement d'un greffon qui, le plus souvent, est le saphène externe (*figure 5.10*). Le brachial cutané interne prélevé à la partie distale du bras suffit à réparer des petites pertes de substance des nerfs digitaux ou collatéraux.

La restauration de la continuité du nerf peut s'effectuer selon deux variantes : la plus classique est celle de Millesi [44] qui nécessite une séparation des groupes fasciculaires et une suture de chaque greffon (*figure 5.11*).

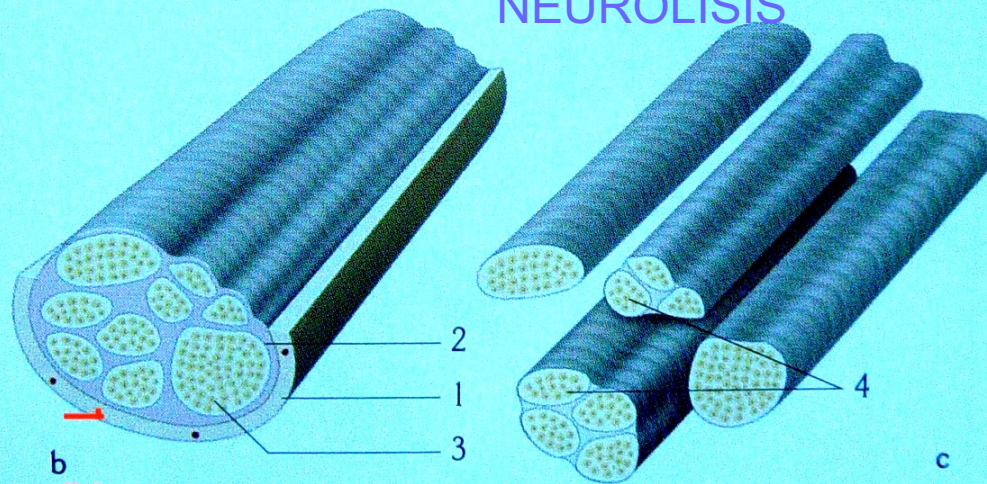


Use nerve graft for a large defect of less than 10 cm, using greater auricular nerve, suralis nerve.

EXTERNAL NEUROLISIS



INTERNAL NEUROLISIS



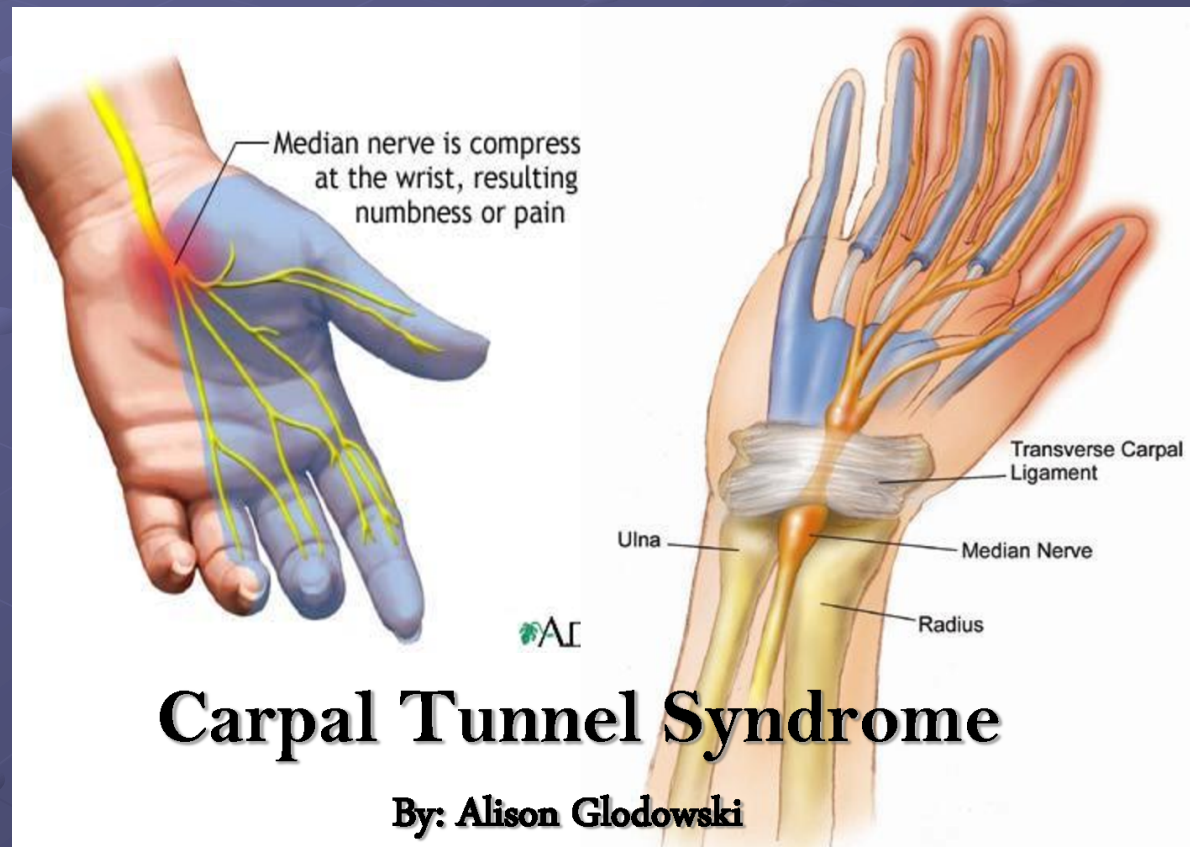
5.9 Les différentes techniques de neurolyses.

a. Épineurotomie de décompression. La simple incision écarte les berges de l'épinèvre permettant aux groupes fasciculaires de faire hernie.

b. Épineurectomie partielle. La résection de l'épinèvre se limite

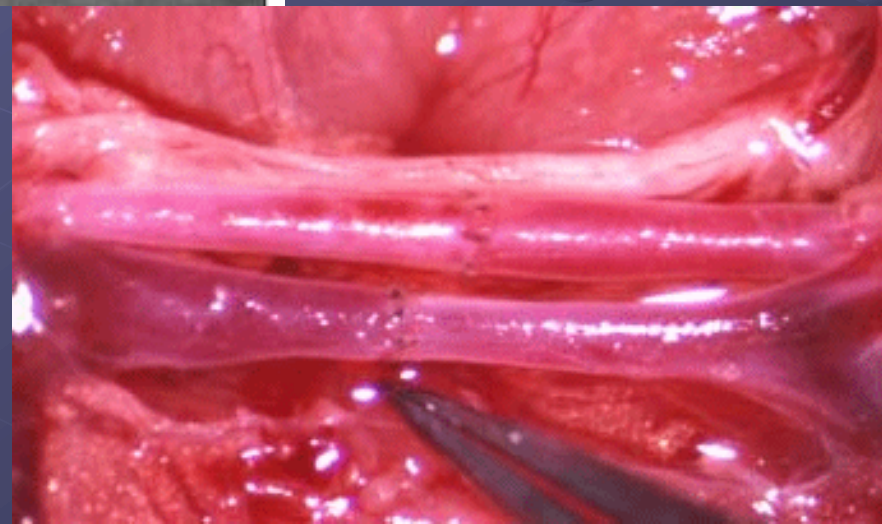
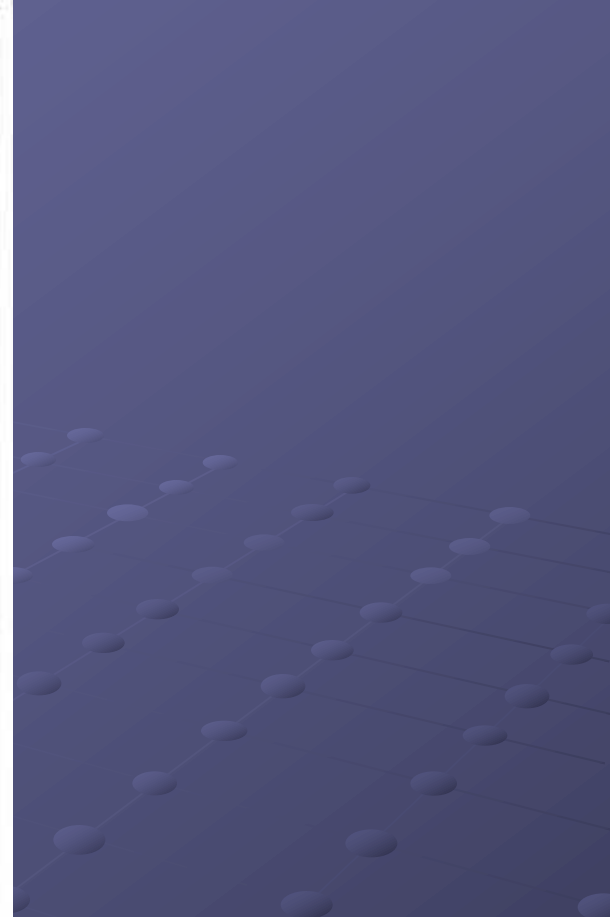
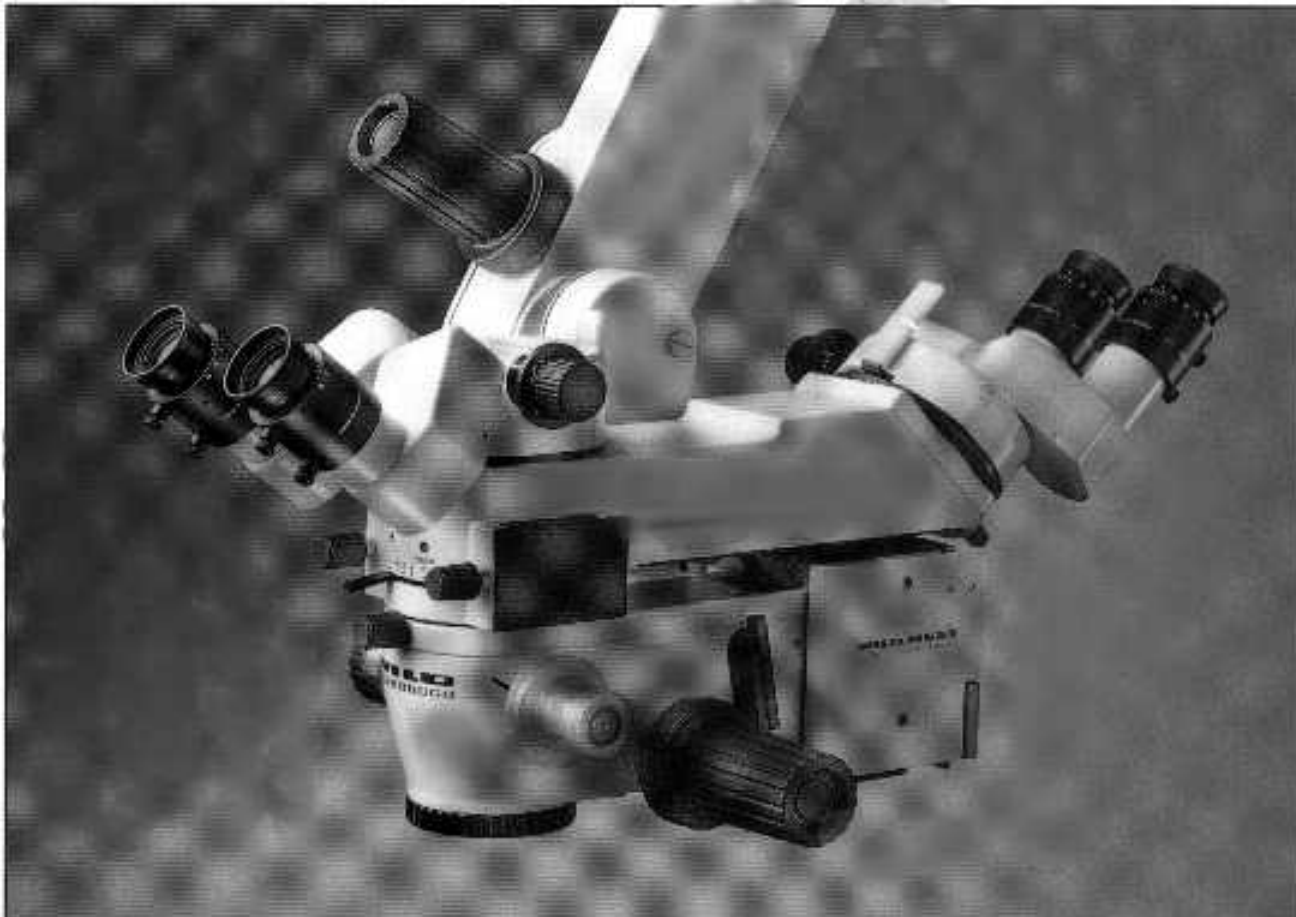
Carpal tunnel syndrome (CTS) is a medical condition due to compression of the median nerve as it travels through the wrist at the carpal tunnel.

The main symptoms are pain, numbness, and tingling, in the thumb, index finger, middle finger, and the thumb side of the ring finger.



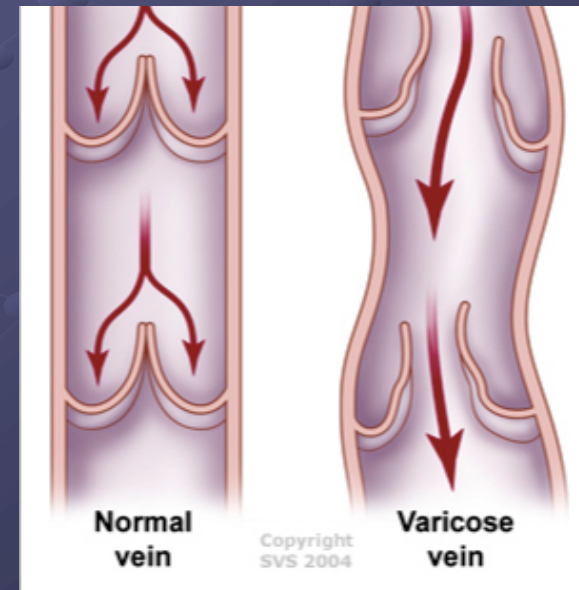


**Microsurgical
sutures on the
small vessels and
nerves in
procedures of
replantation**



Varicose Veins

- Varicose veins result from an enlargement and dilatation of veins just beneath the skin and occur mainly in the legs.
- This enlargement of the veins results from a weakening in the vein wall, and a dysfunction of vein valves which regulate blood flow through the vein.
- The condition can be aggravated by pregnancy, obesity, and occupations requiring long periods of standing.



Varicose Veins Treatment

- **Stocking** (Some of the symptoms of varicose veins can be treated without intervention by wearing support stockings during the day)
- **Sclerotherapy** is often used to treat spider veins, smaller varicose veins, hemorrhoids and hydroceles.- Sclerosing agents typically used include: polidocanol; sodium tetradecyl sulfate; hypertonic saline solutions to obliterate the vein.
- **Foam sclerotherapy** - the solutions that are injected are exactly the same as those which are already used to treat varicose veins. These are mixed with a gas to create a mousse or foam consisting of very small bubbles
- **Surgery**

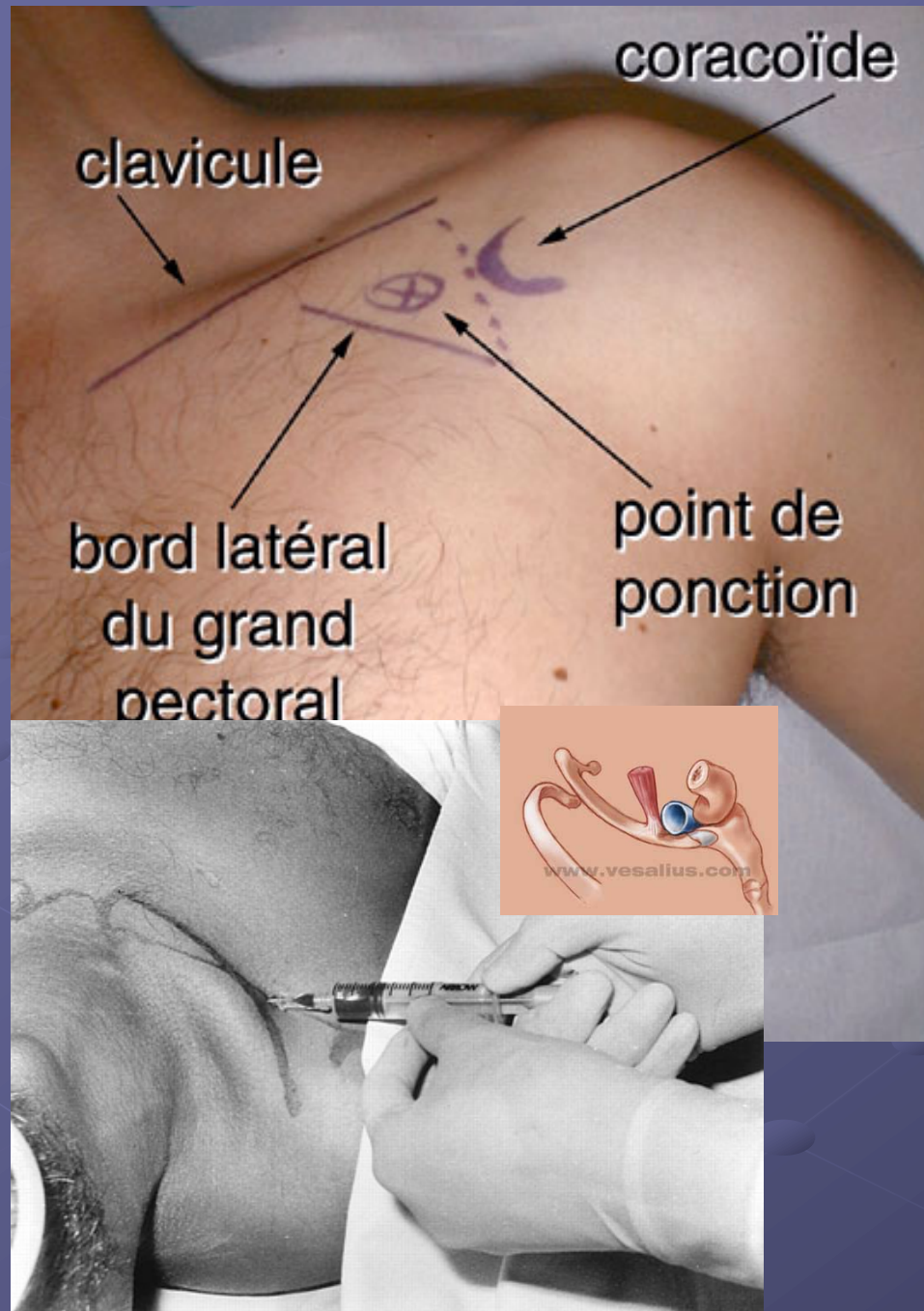
VENOUS CATHETERISATION

Is provided by percutaneous insertion of one or two intravenous plastic catheters.

Indications:

- operations or traumas associated with marked blood loss for rapid administration of blood, fluids or medications.

- Prepare 19 gauge catheter with 10ml syringe on the end of the catheter
- Place patient in Trendelenburg's position at 15° with head turned to the opposite side of the procedure site.
- Locate the intersection of the middle and medial thirds of the clavicle (the subclavian vein lies deep to this point).
- cleanse the selected venipuncture site with antiseptic swabs



Insert the needle until it contacts the superior edge of the clavicle.

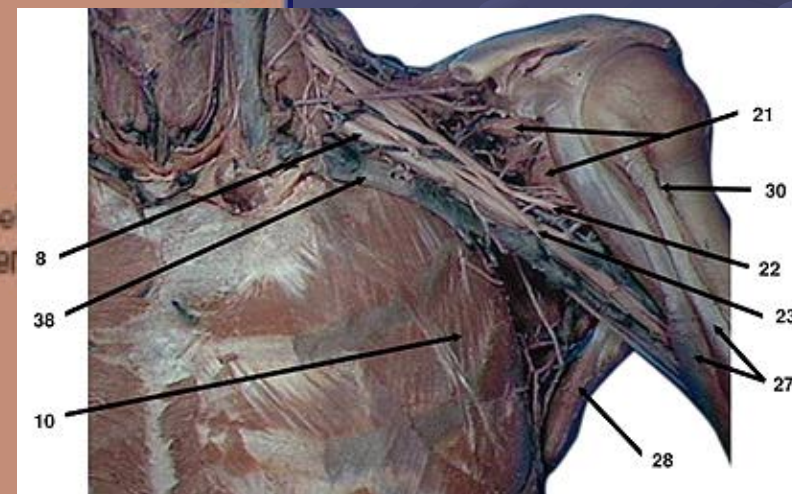
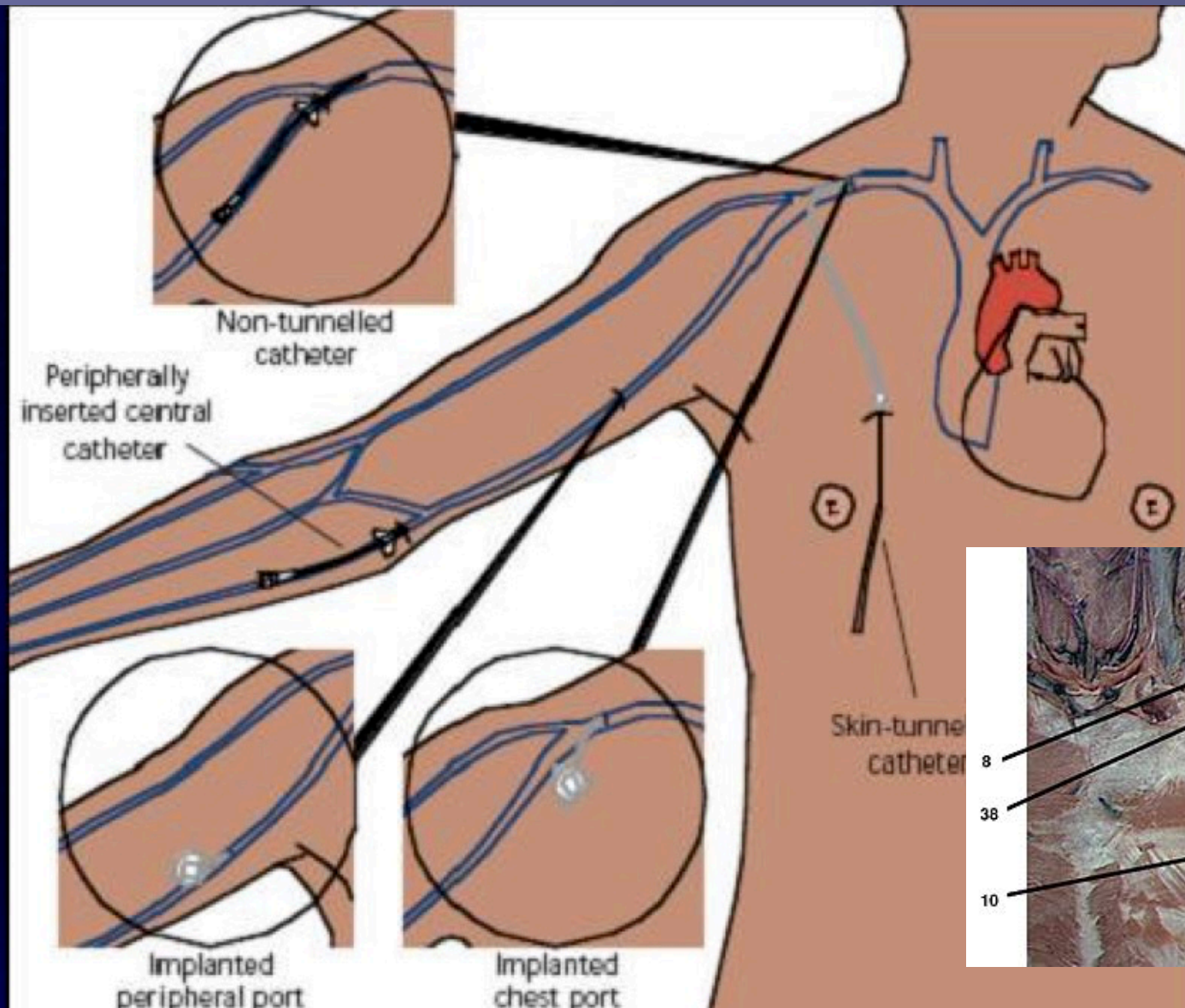
Lower the needle tip below the clavicle and direct the needle parallel to the floor.

Aspirate the syringe as the needle is inserted.

When blood appears in the syringe, thread the catheter into the vein.

If no blood returns is obtained or if resistance is met, redirect the needle toward the patient's opposite shoulder. (do not, at any time, direct the needle toward the patient's feet.

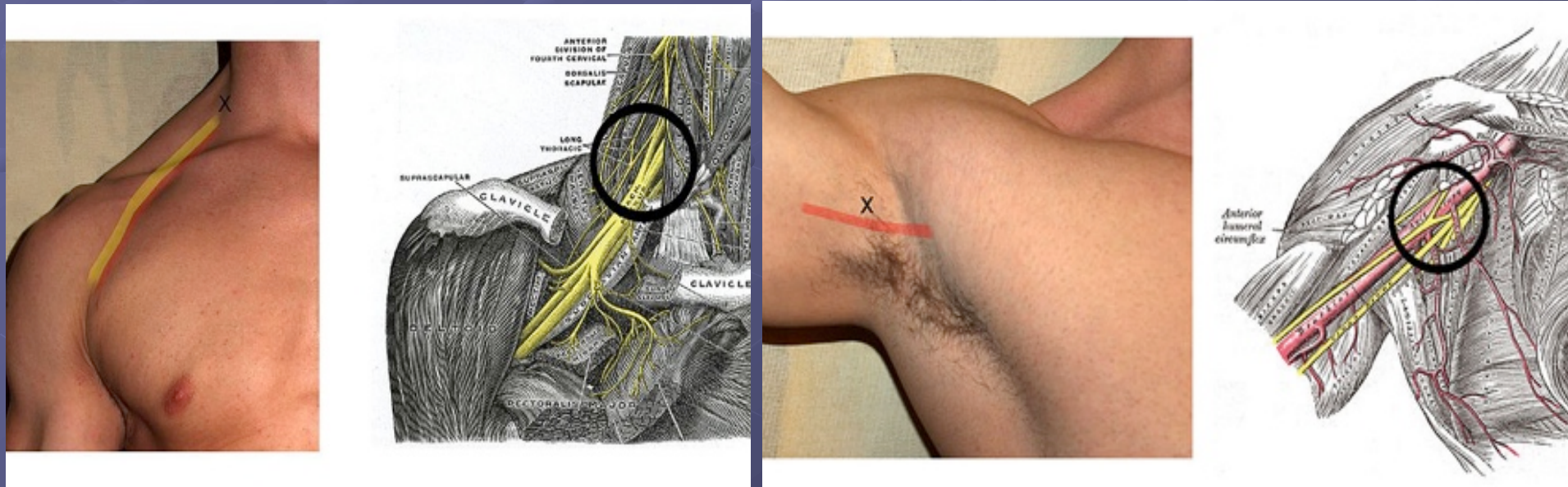
Holding the catheter in place, quickly withdraw the needle and attach the tubing to the catheter hub.

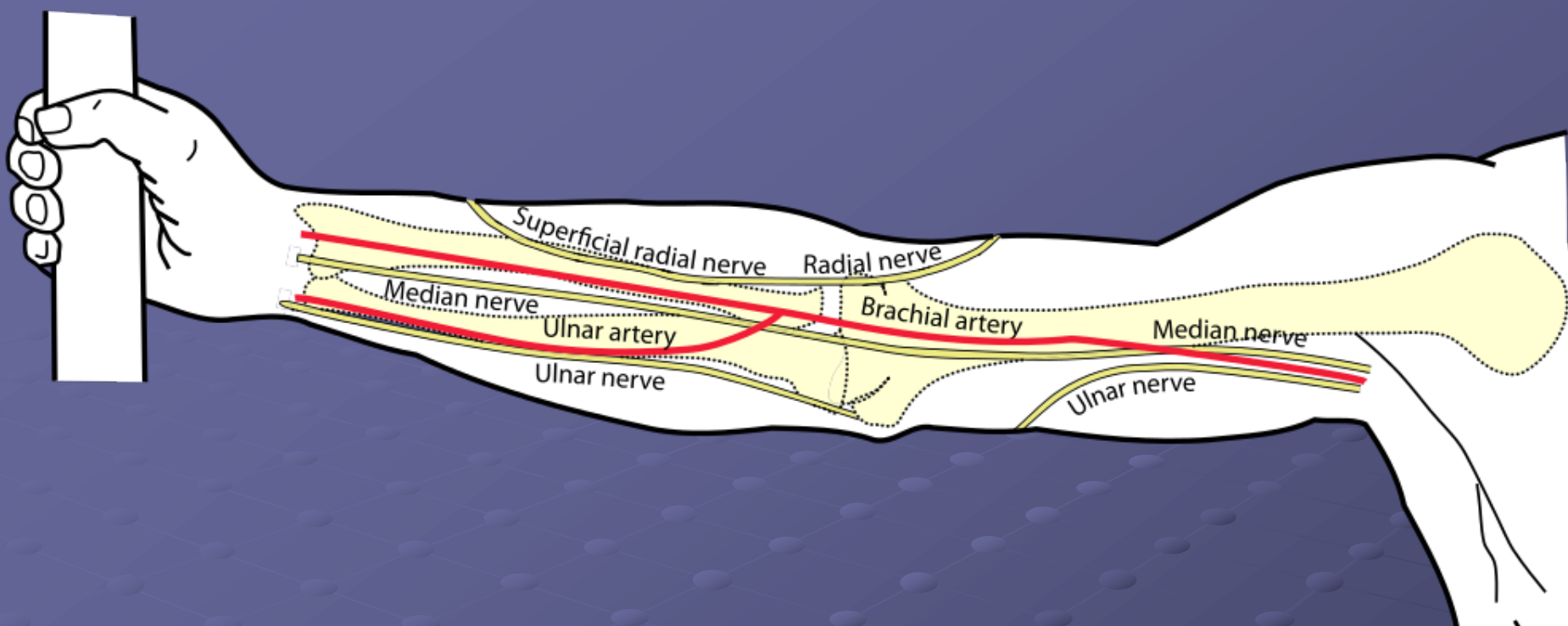


Regional anesthesia

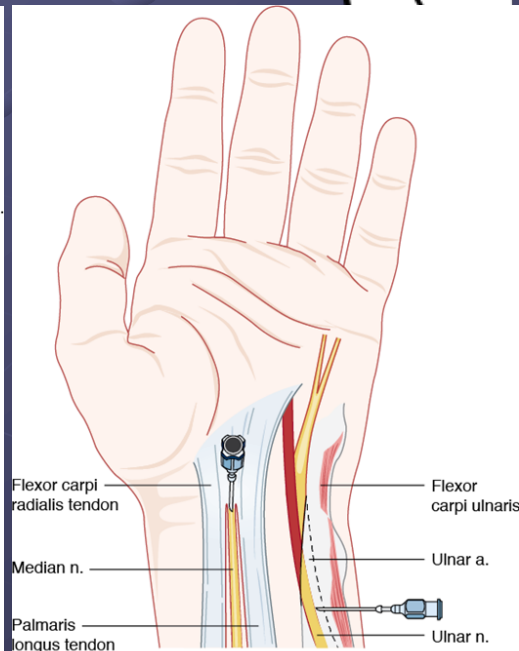
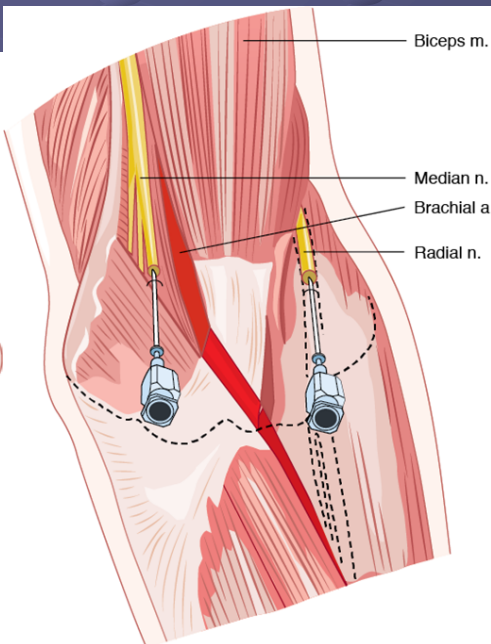
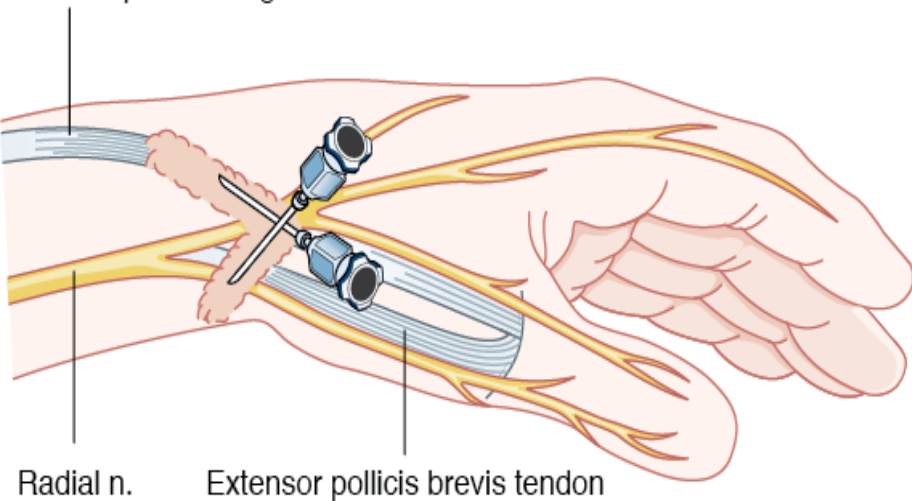
Brachial plexus block is a regional anesthesia technique that is sometimes employed as an alternative or as an adjunct to general anesthesia for surgery of the upper extremity.

These techniques are classified by the level of injecting the local anesthetic — **interscalene block** on the neck, **supraclavicular block** immediately above the clavicle, **infraclavicular block** below the clavicle and **axillary block** in the axilla (armpit)





Extensor pollicis longus tendon



Femoral Nerve Block

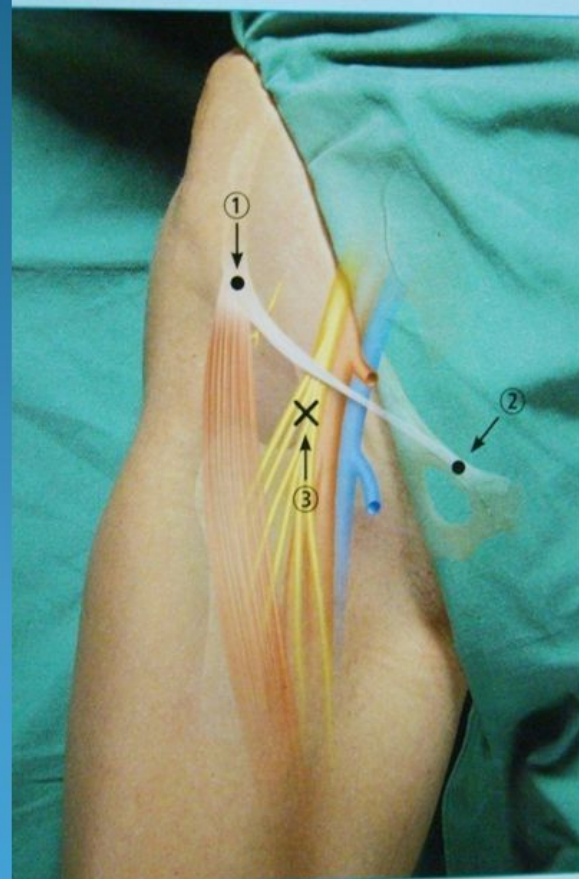
Blockade technique

The patient lies on his back, his leg loosely abducted and turned to the outside.

Puncture site:

2cm caudad to the groin,
1 – 2 cm lateral to the
femoral artery.

Anatomical landmarks



Sciatic nerve blockade is useful for postoperative pain, for lower extremity surgery, and lower extremity chronic pain syndromes such as sciatic neuropathy. x

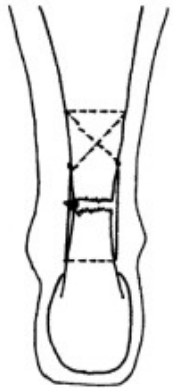
The patient is first placed in the lateral position with the side to be blocked up. While the lower leg is kept straight, the thigh is flexed at the knee so that the ankle is brought over the knee of the other leg. A line is drawn between the greater trochanter (A) and the posterior superior iliac spine (B). The line lies approximately over the upper border of the piriformis muscle. From the midpoint of this line (D), at right angles to it, a second line passing over the buttock is drawn. The point of injection is 3 - 5 centimetres along this perpendicular line. It can be more precisely identified by drawing a third line between the greater trochanter and sacral hiatus, the point of injection being where this third line intersects with the second, perpendicular line.

Tenorrhaphy, [teno- + G. *rhapḗ*, suture]

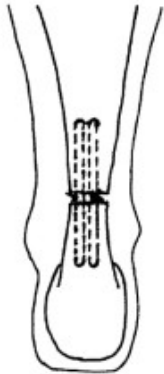
Suture of the divided ends of a tendon.

Synonyms tendinosuture, tendon suture, tenosuture

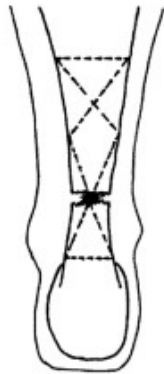
Percutaneous & Minimally Invasive Suture Techniques



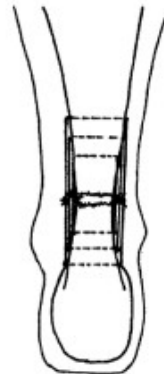
Ma & Griffiths



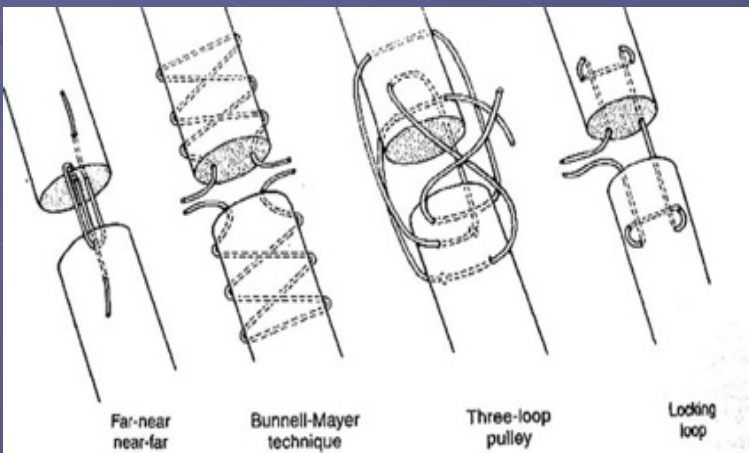
Webb & Bannister



Carmont & Maffulli



Assal & Achillon



**THANKS FOR
YOUR
ATTENTION !!!**

