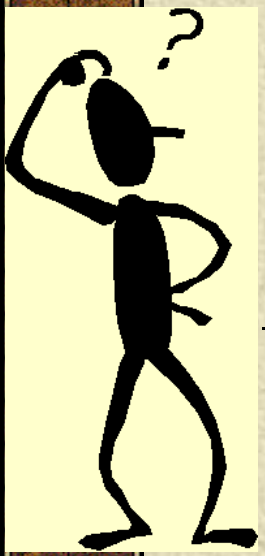


“Bone and Jont surgery”

PhD, MD, MPH, professor
Viorel Nacu

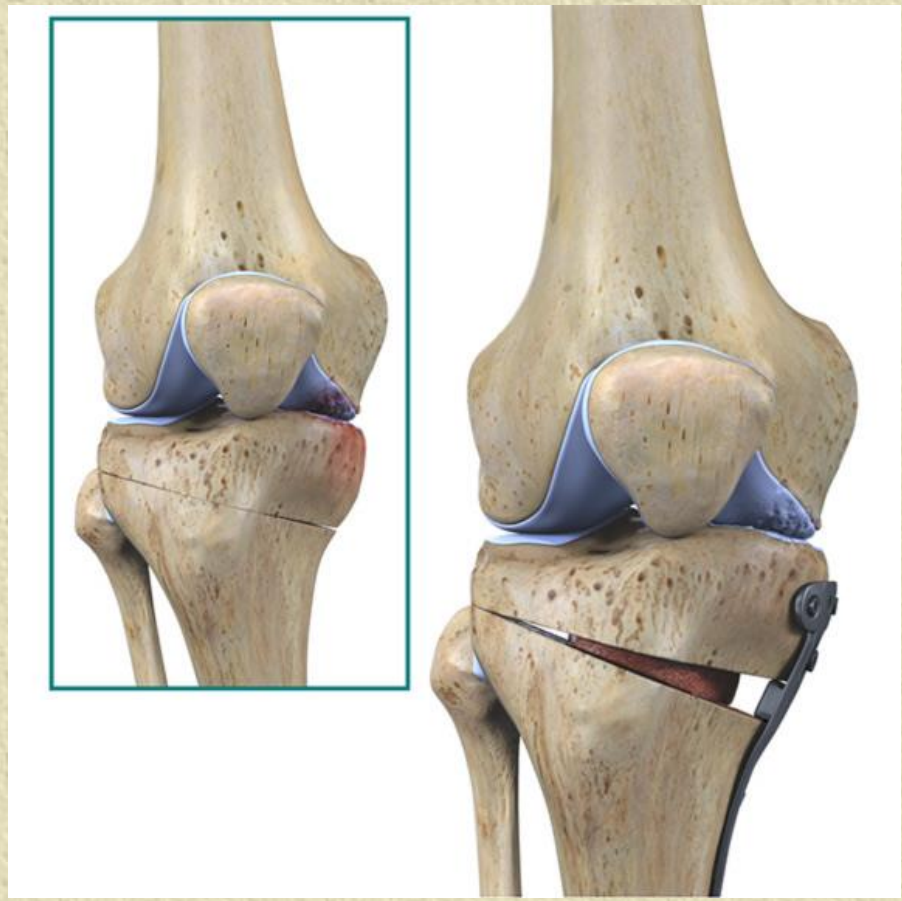
The traumatism of the skeleton borrows (occupies) one of the first places in structure of diseases requiring urgent surgical intervention.

Skeleton Surgery :

1. Bones Surgery
2. Joint Surgery

Bone surgery:

- Skeletal pin traction
- Osteosintesis
- Osteotomy
- Bone resection
- Bone grafting
- Sequestrectomy



Osteosintesis – is the fracture reduction performed by open or closed technique.

Closed techniques - involve traction, plaster casts or splint

Open techniques – involve surgical application of hardware to secure fixation of the bone fragments.

The methods of osteosinthesis:

Internal fixation - Open reduction internal fixation is a method of surgically repairing a fractured bone. Generally, this involves either the use of plates and screws or an intramedullary (IM) rod, nail to stabilize the bone.

The open osteosynthesis

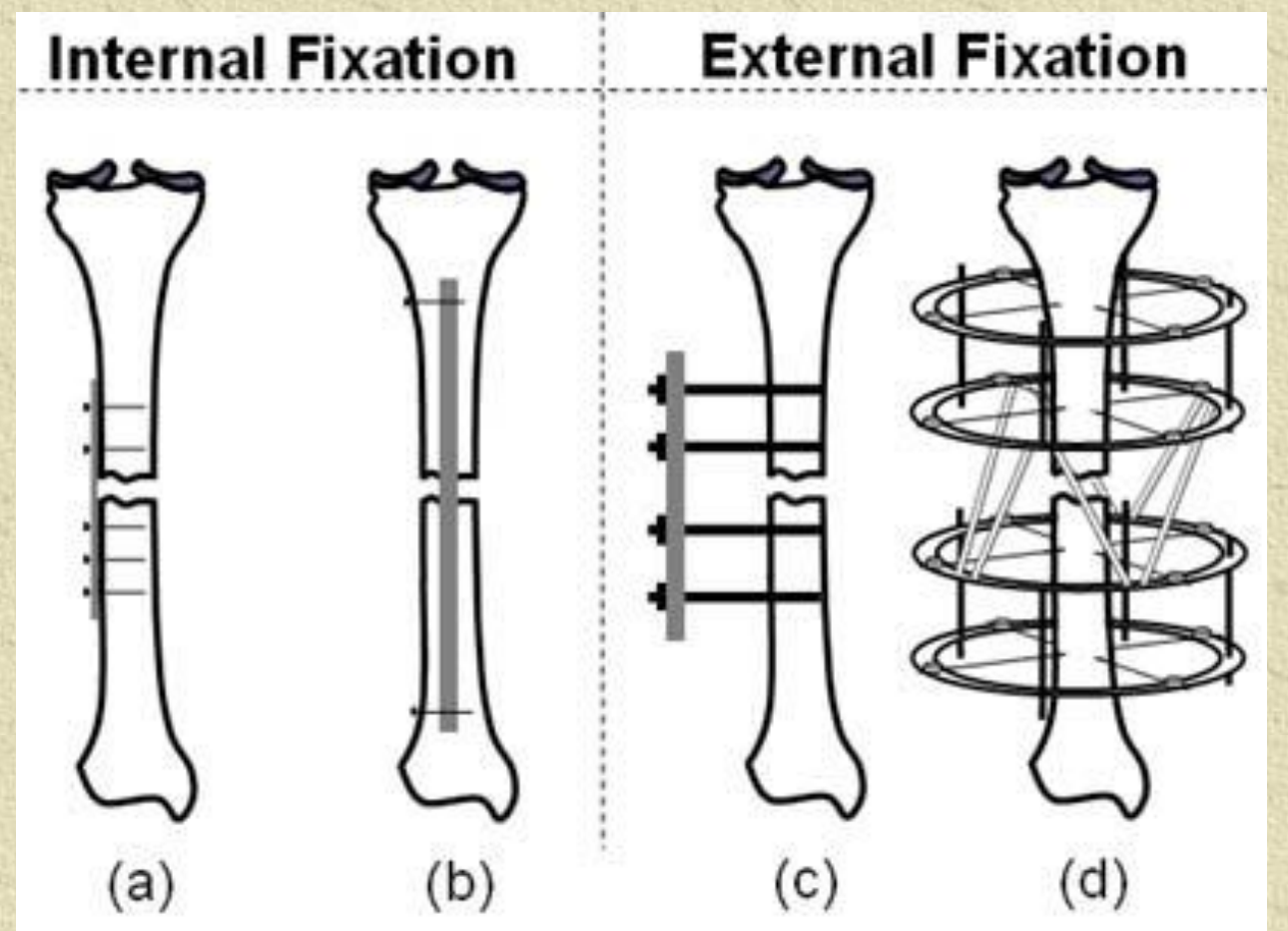
– When the skin is sectioned at the place of fracture. The closed osteosynthesis - when fixing agents are entered above or below a place of fracture and the place of fracture is not opening.

Lack of osteosynthesis - necessity of removal of fixing agents, researches of the biodegradable fixing agents.

Bone Fixation:

External

Internal



External fixation is a method of immobilizing bones to allow a fracture to heal.

External fixation is accomplished by placing pins or screws into the bone on both sides of the fracture.

The pins are then secured together outside the skin with clamps and rods. The clamps and rods are known as the "external frame."

Advantages of external fixation are that it is quickly and easily applied.

The risk of infection at the site of the fracture is minimal, but there is a risk of infection where the pins are inserted from the skin into the bone.

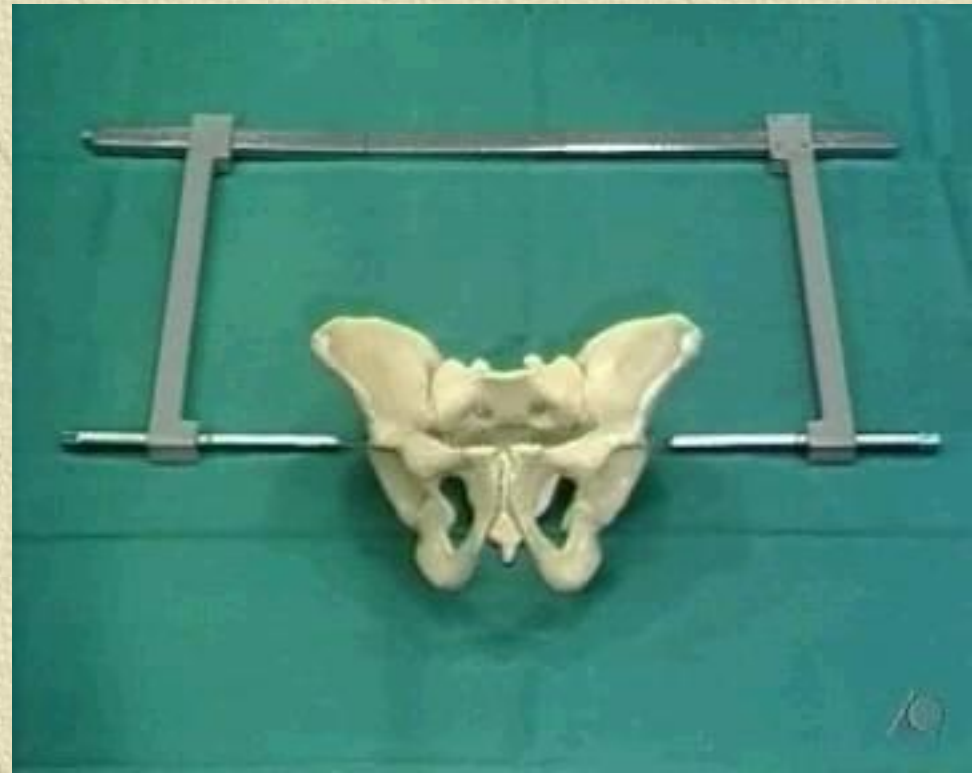
Internal fixation

1. **Serclage wires. Having passed this device round the shaft of the bone and then twist the ends up firmly with one of the several of wire-twister.**

2. **Transcortical** (scrw, wire)

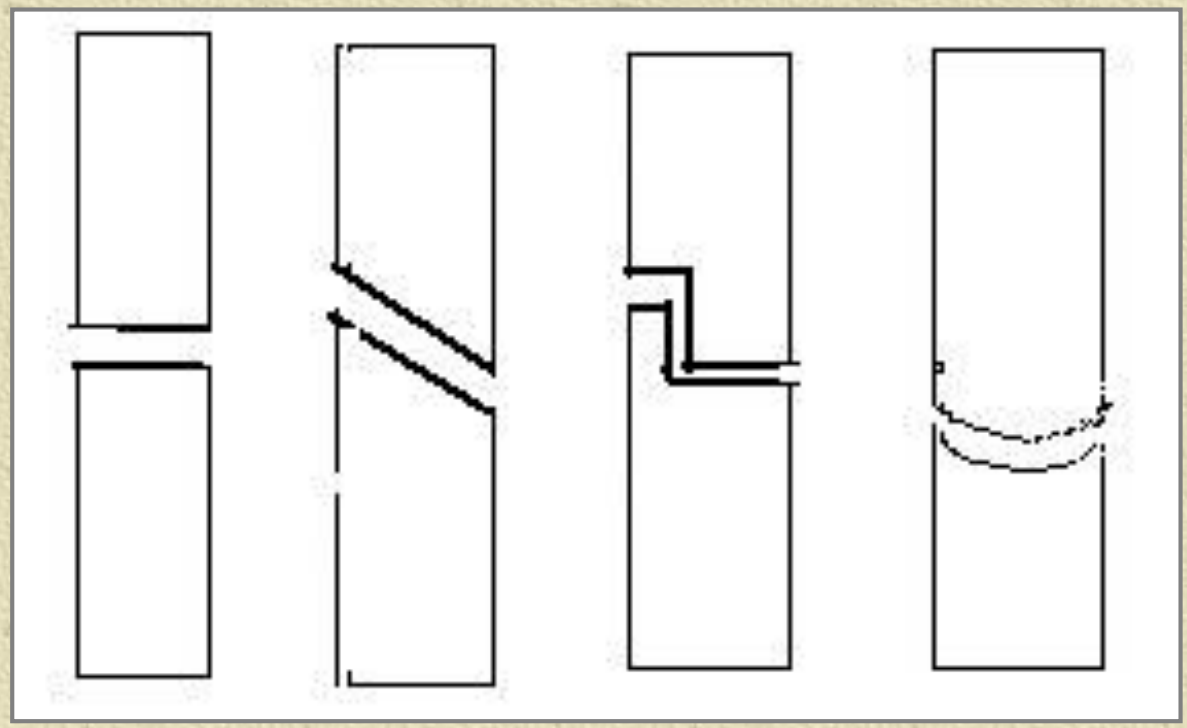
3. **Medullary nails** (rods) **- (** Kuntscher 1940**) -** used for the long bones such as the femur or humerus.

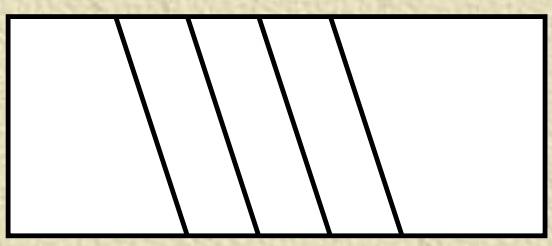
Pelvic fixator used for pelvic fractures, particularly those of the open book type. Three pins are inserted into each iliac crest and attached to metal rods used to “close” the open book injury



Osteotomy – cutting of the bone.

The types of the osteotomy





♣ **Bone Resection** – cutting off the parts of bone.

On techniques of performance distinguish:

- *under periosteally*
- *transperiosteally*
- *Partial*
- *Total*

- **Bone grafting** is the procedure of transplanting bone from a donor area to a recipient area. The technique consists of placing live bone pieces in close contact with a healthy raw bone surface to stimulate growth of bone tissue in the new area.

Indications:

1. In the treatment of non-union of fractures.
2. For filling cavities in bone.
3. For bridging gaps in the shafts of bones caused by trauma, infection or excision of tumour.
4. In the surgical fusion (arthrodesis) of joints.

Types of Bone grafts

The bone used for grafting may be obtained from a donor site from

- **a) autogenous graft -** the same person (rib, the fibula, a part of femur, tibia or Ilion). It can be free or vascularized.
- **b) homogenous graft or allograft** a different person (isigraft – transplant between a genetically identical pair (monozygotic twins)
- **c) heterogenous xenograft -** a different species transplantation between species, like calf or pig.
- d) **regenerative medicine - tissue engineering, cells therapy, gene therapy.**

- **The best is the autogenous graft but it is difficult to get enough bone for use in children. In such cases, the maternal homogenous graft is the best alternative source.**
- **_Cadaver bone_, stored in Tissue Banks is extensively used not only to fill gaps but also to replace diseased ends of long bone or even total joints.**
- **In terms of anatomical types, the graft may be:**
- ***Cortical*** **bone graft in various shapes or** ***Cancellous*** **bone pieces.**
- **The cancellous bone is more osteogenic as its vascularisation is quicker and bone induction better. The cortical bone functions as a fixation device and cancellous bone promotes osteogenesis.**

Vascularised bone graft

The success and the rate of integration of the bone graft with the recipient site is vastly improved when the blood supply is retained. This procedure requires the anastamosis of the vessels by *microsurgical* methods in addition to the fixation of the bone.

This is used mostly while using fibula or rib as a graft.

Bone Bank

With increasing use of bone grafting procedures for various condictions, the need for large quantities of bone is great.
Thets why appears the necessity in bone banks with special techniques of storage in sterile condition.

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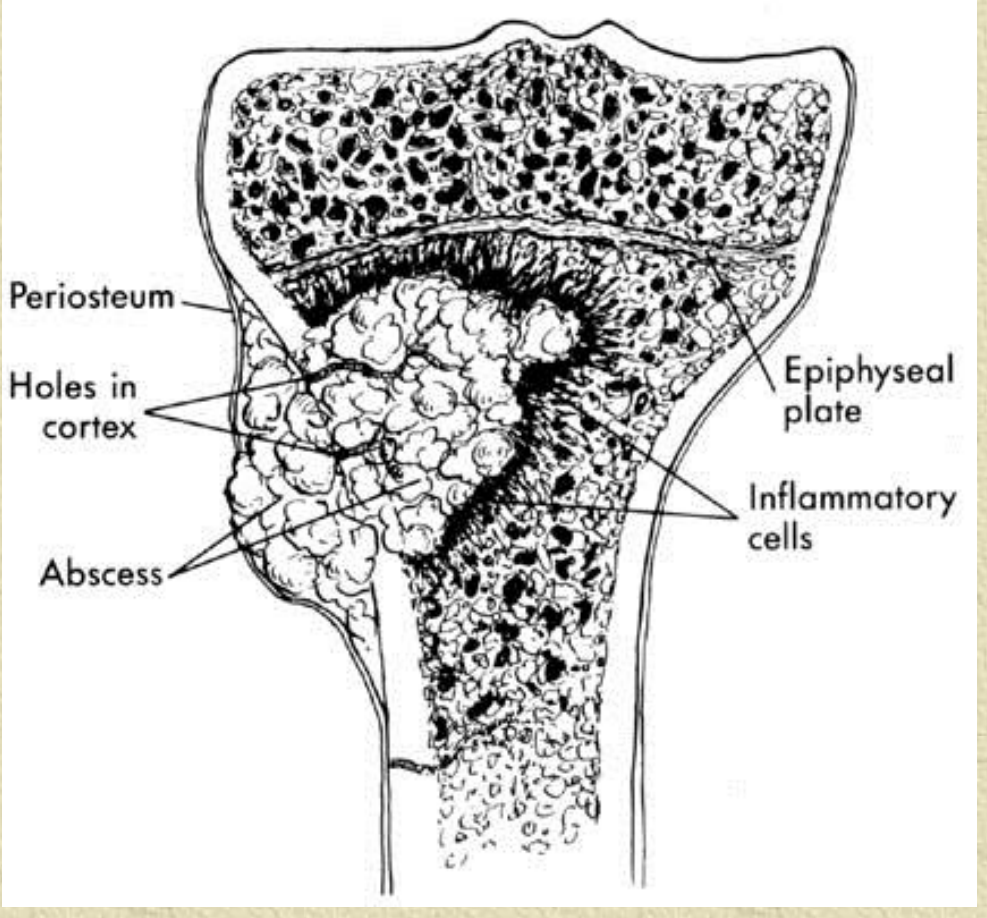
♣**Sequestraectomy – it's perform** in case of **chronic osteomyelitis**. An elliptical incision is used to excise adherent skin with sinuses. All dead bone on this subcutaneous surface is removed by lifting a window of cortex with sinuses and adherent skin attached. Surgical treatment will only succeed if all infected tissue and all dead bone are removed. The coverage is obtained with muscle pedicle grafts and adequate bone reconstruction.



Joints Surgery

Arthrocentesis (Join Puncture),

Arthrotomy,

Arthrodesis,

Arthrolysis,

Arthroplasty,

Joint resection,

Arthroscopy

Joint Puncture

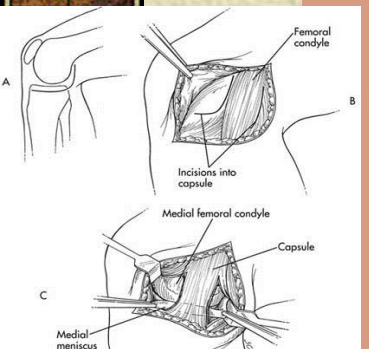
diagnostic

therapeutic

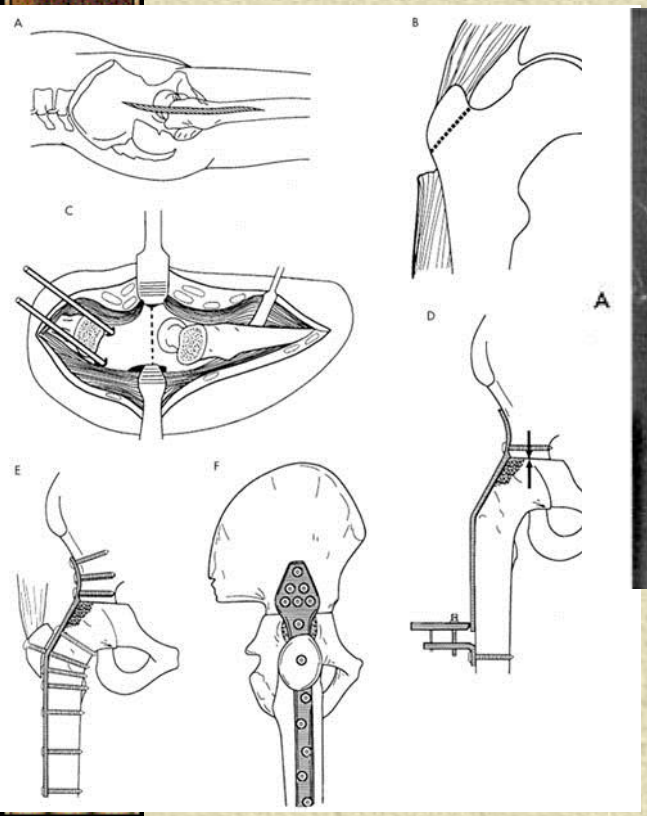
Arthrotomy - it's the opening of the joint;

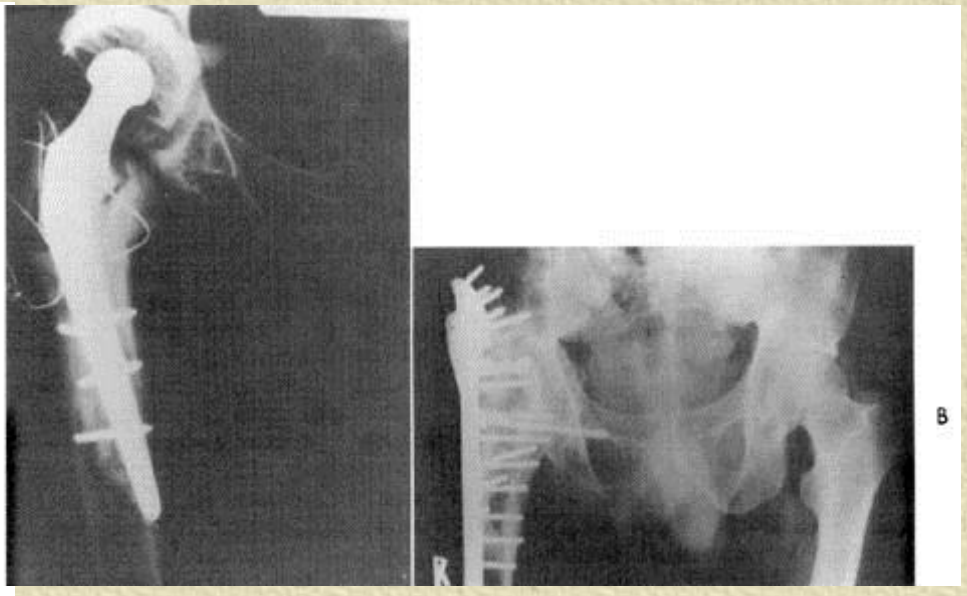
Joint resection (tumors; tuberculosis; aseptic necrosis. It can be partial o total);

Arthrodesis - operation directed on creation of an immovability in a joint in functional favorable position. Indications: arthritis with the expressed painful syndrome, **dangling joints after a poliomyelitis, chronic dislocations.**

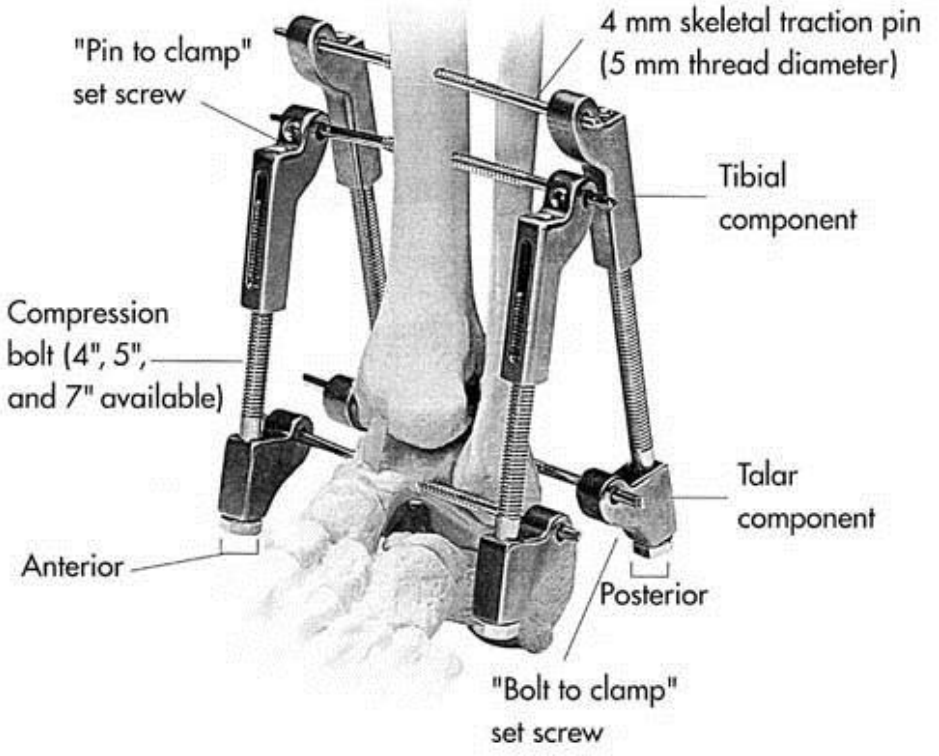


This operation is carried out only exceptionally nowadays. In this operation, the surgeon removes all joint surfaces up to the raw bone and then presses and fixes the denuded joint surfaces together with special plates and screws. Healing of the arthrodesis - solidifying of the bone tissue and obliteration of the previous joint space - takes about 12 weeks.





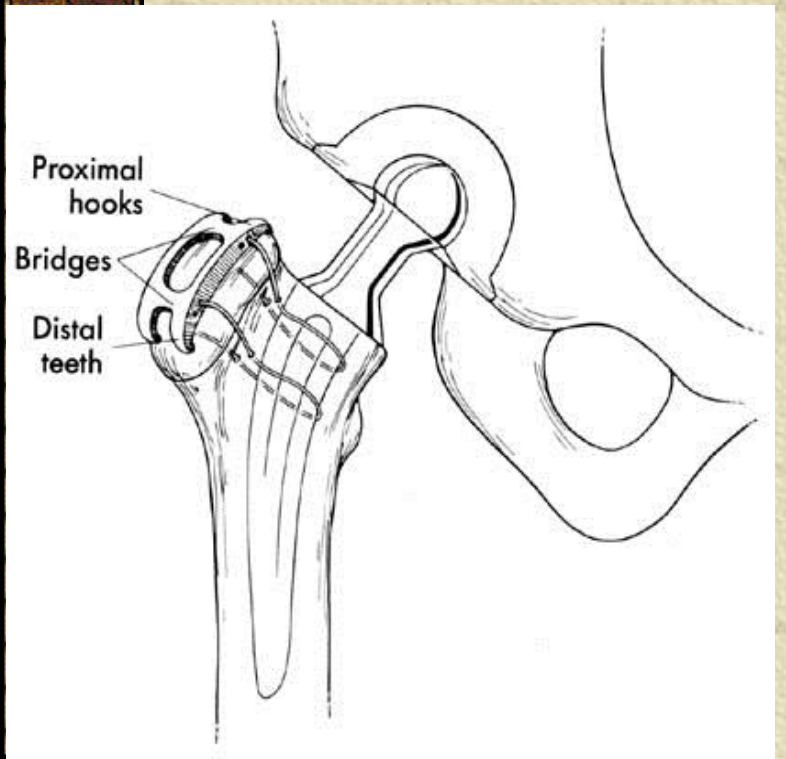
Arthrodesis of the ankle joint

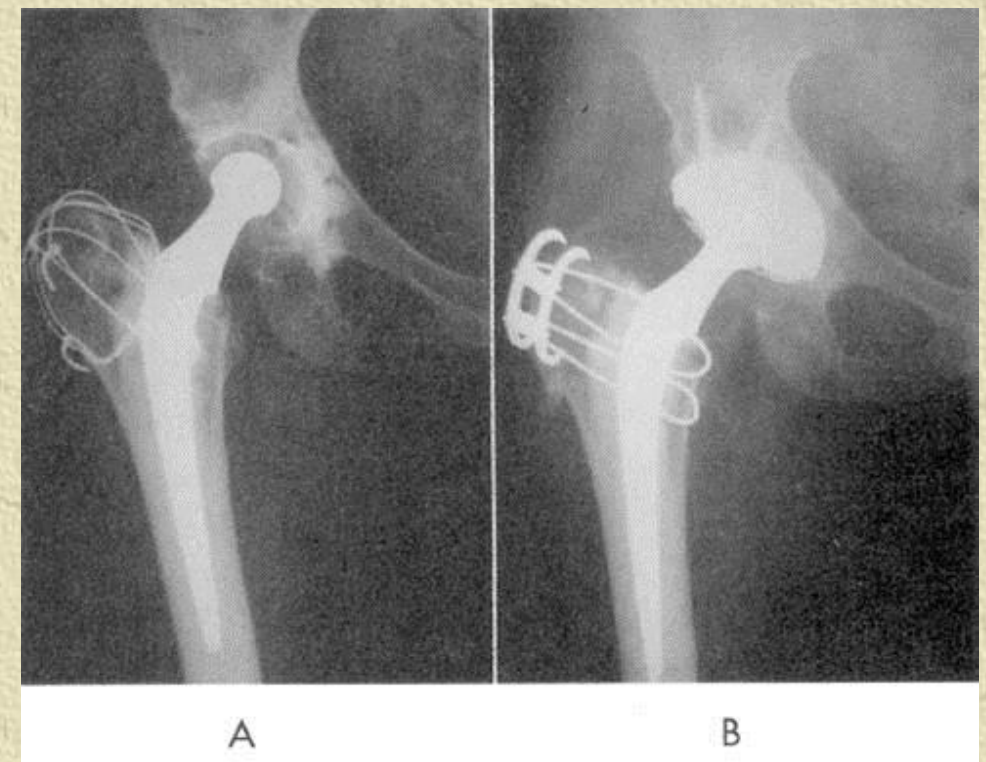


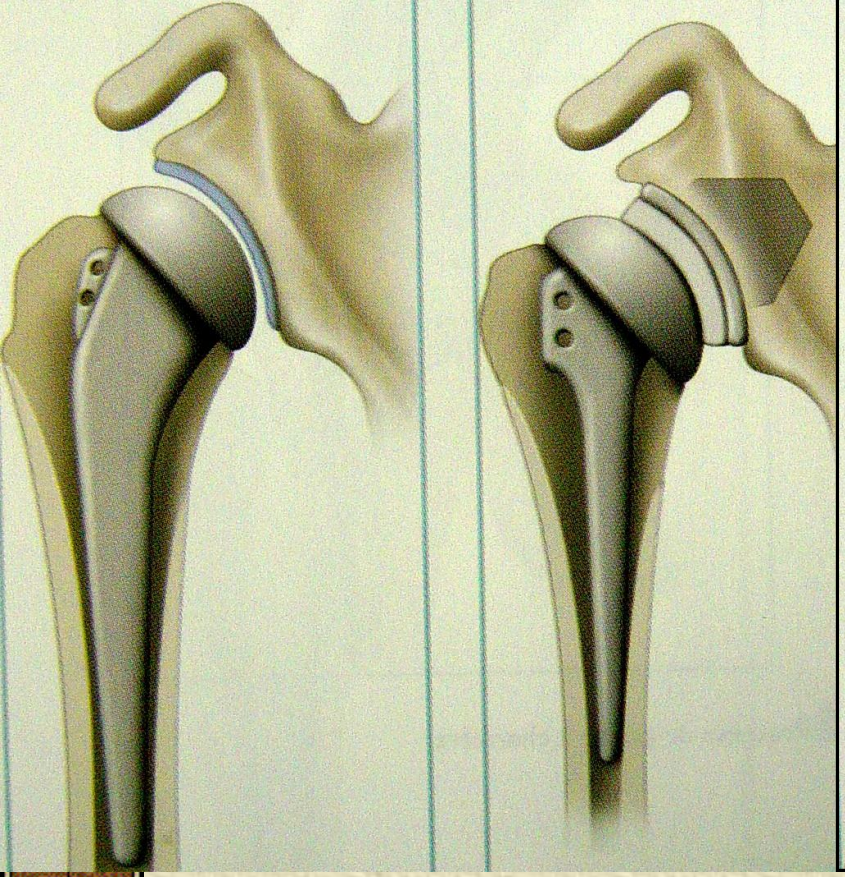
Arthrolysis – is removal (cutting) of the intrarticulare adherences.

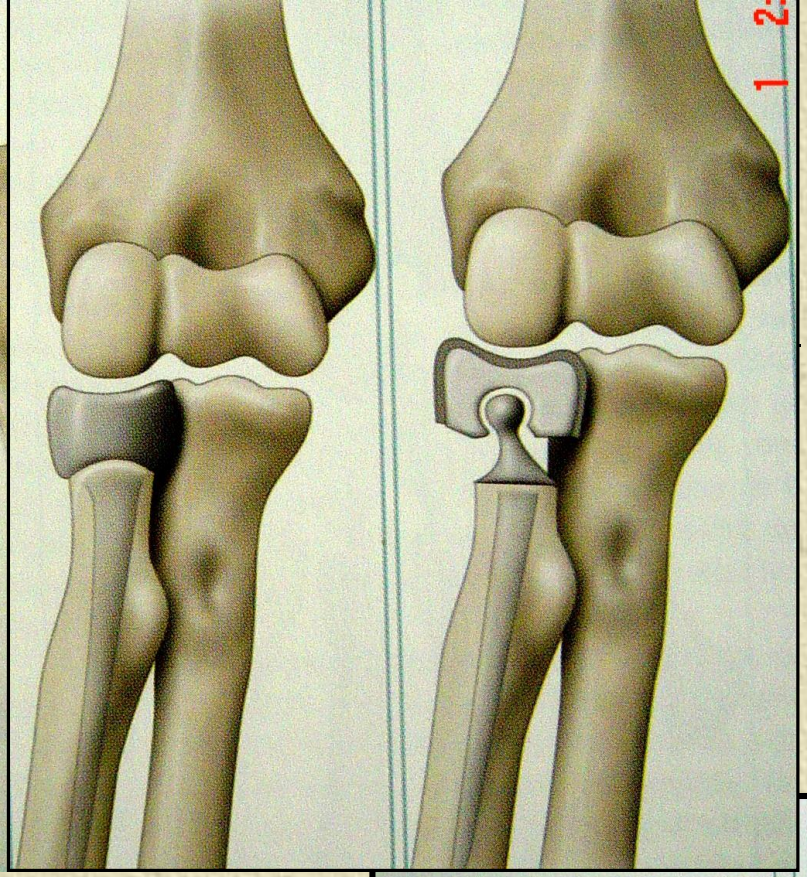
Arthroplasty - It is directed on restoration of mobility in joint by formation of articulate surfaces. It can be by plasties whth fascies, skin or cartilage grafts.

- Endoprostesis - replacement of the damaged with an syntetic on.

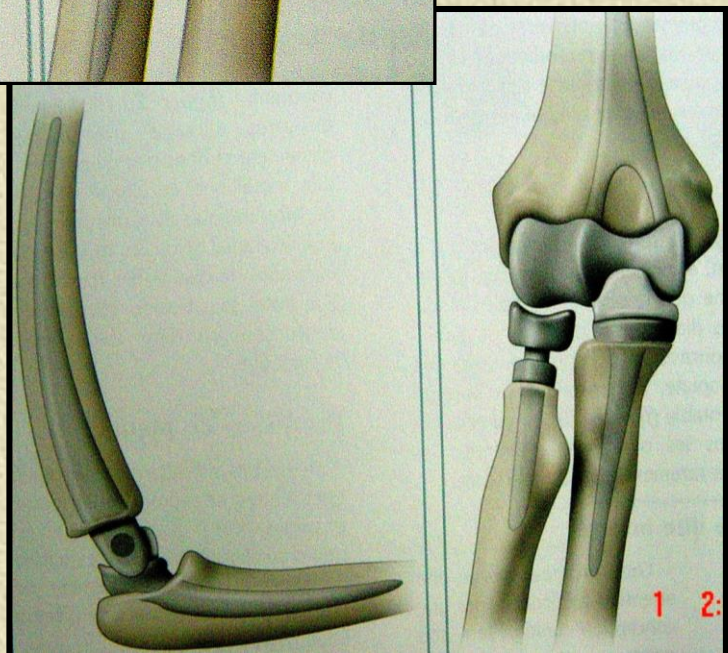




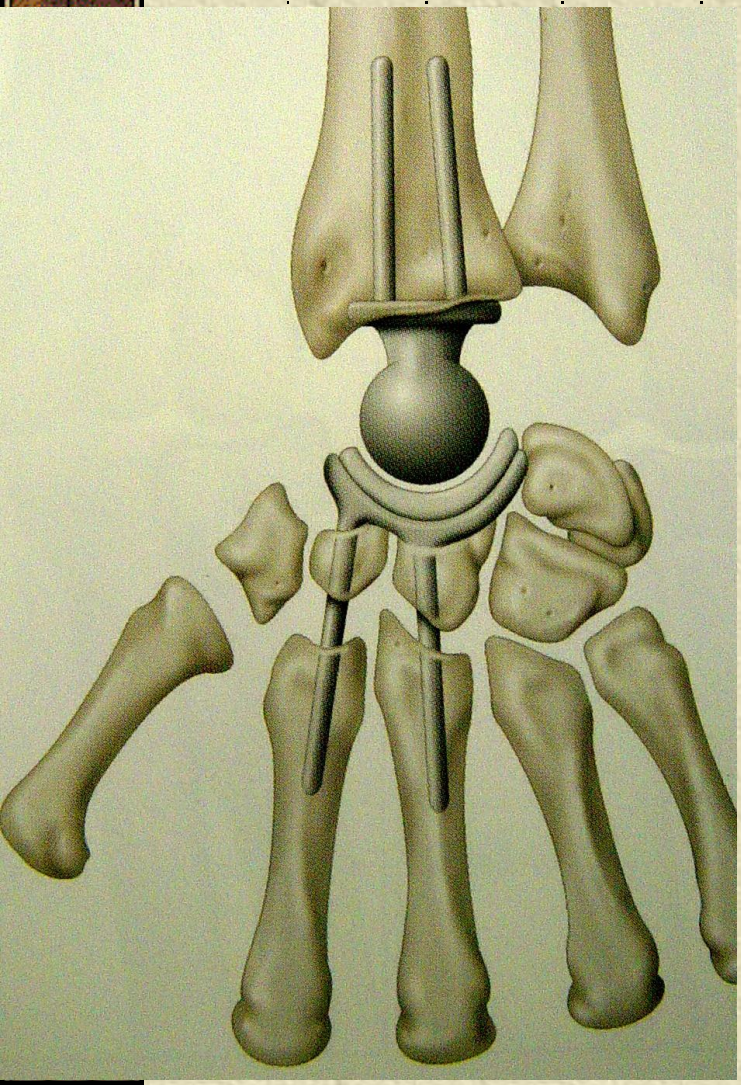


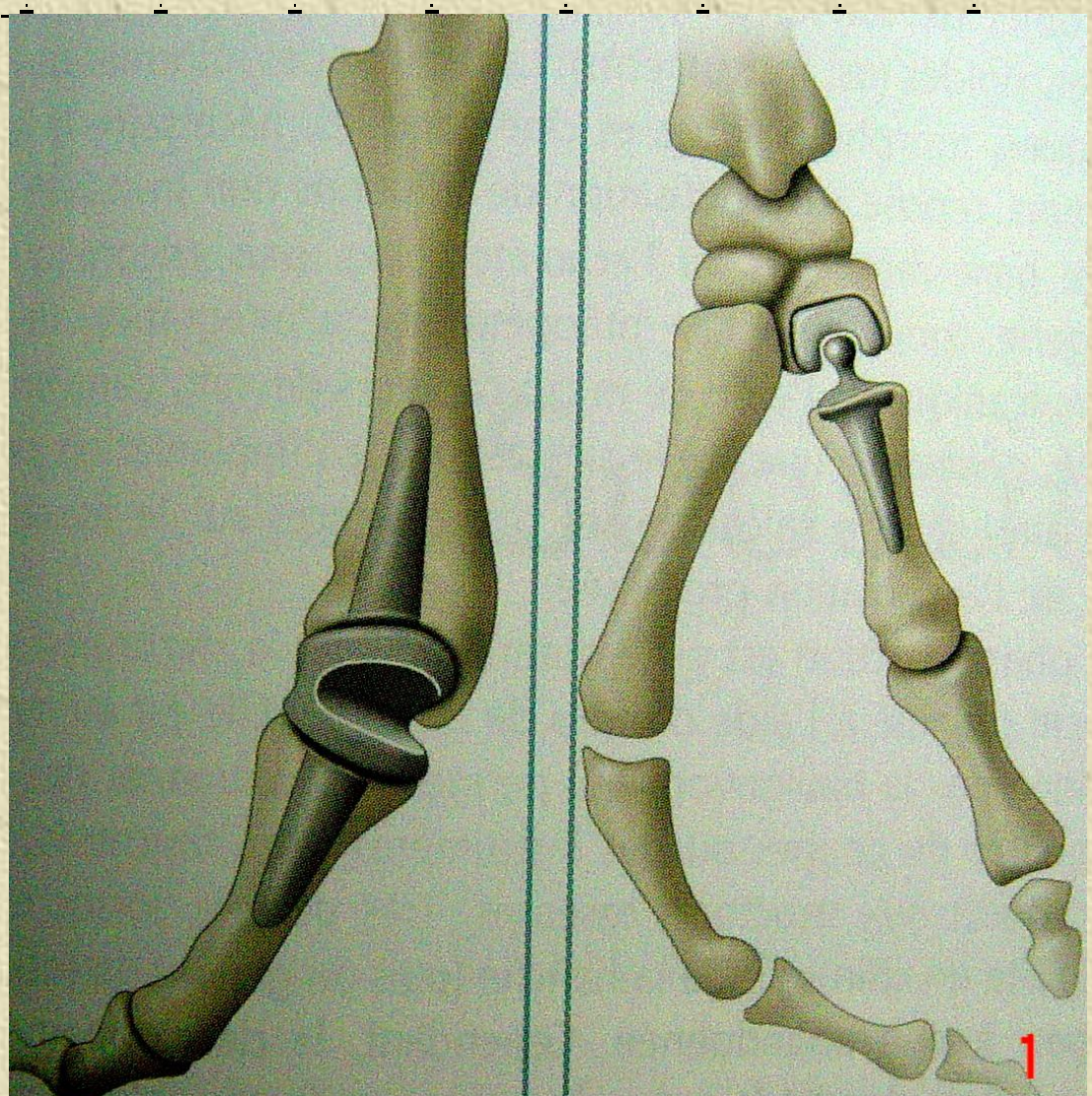


Endoprostesis of the shoulder



The destroyed joint surfaces are resected and precisely replaced by prosthetic implants. These implants are fixed either cementless or with bone cement. There are different types of prostheses available like unicondylar or totalcondylar prosthesis. For the implantation of these modern prosthesis only a very small bone resection is necessary. The main ligamentous structures like collateral ligaments and posterior cruciate ligament (PCL) are spared. There is always a component for the femoral and the tibial part, whereas the replacement of the patellar surface is not necessary in most of the cases.

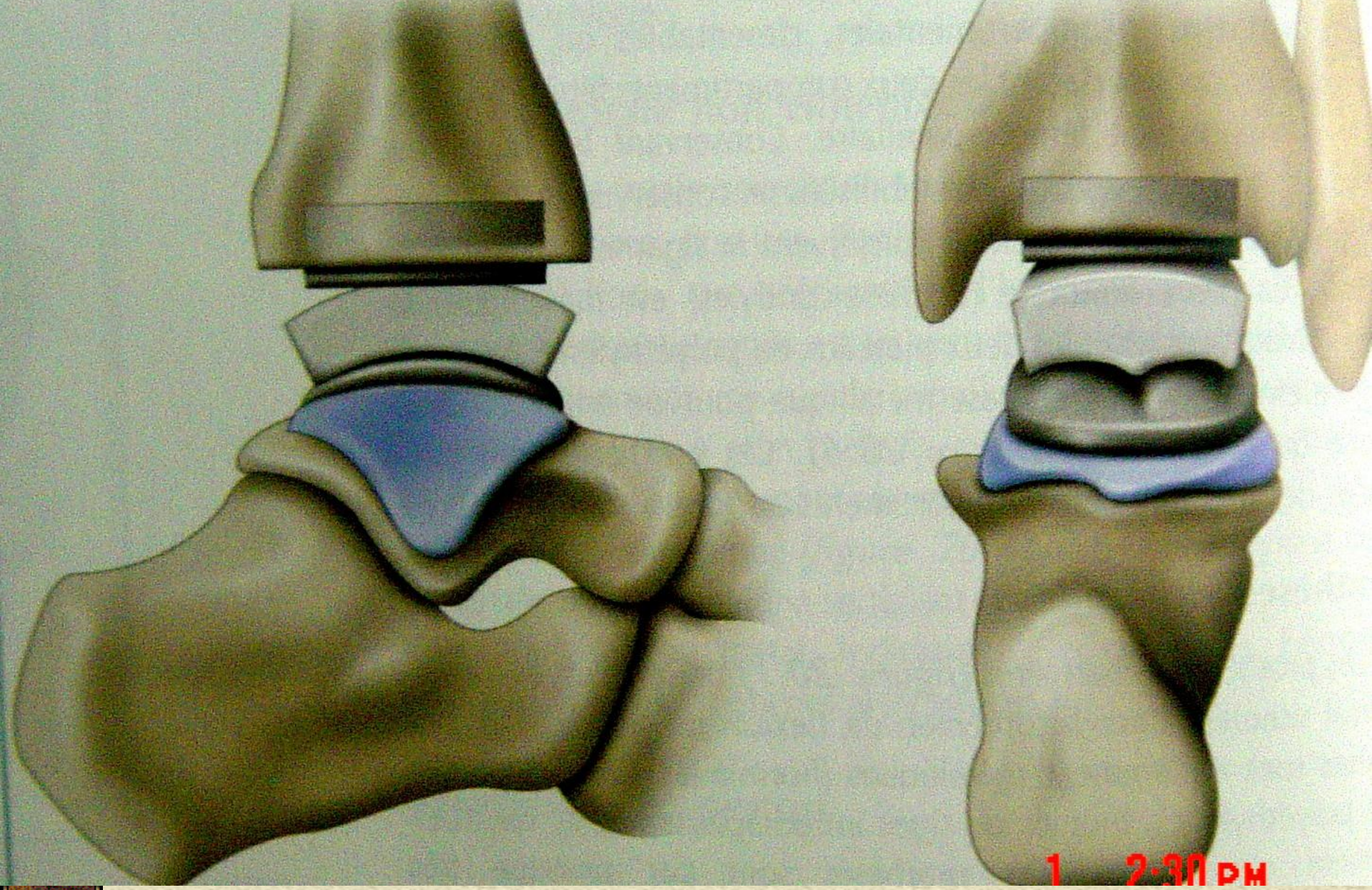




Totalcondylar prosthesis
x-ray of a totalcondylar prosthesis right knee

Unicondylar prosthesis
this type of prosthesis is used in osteoarthritis, limited to one joint compartment

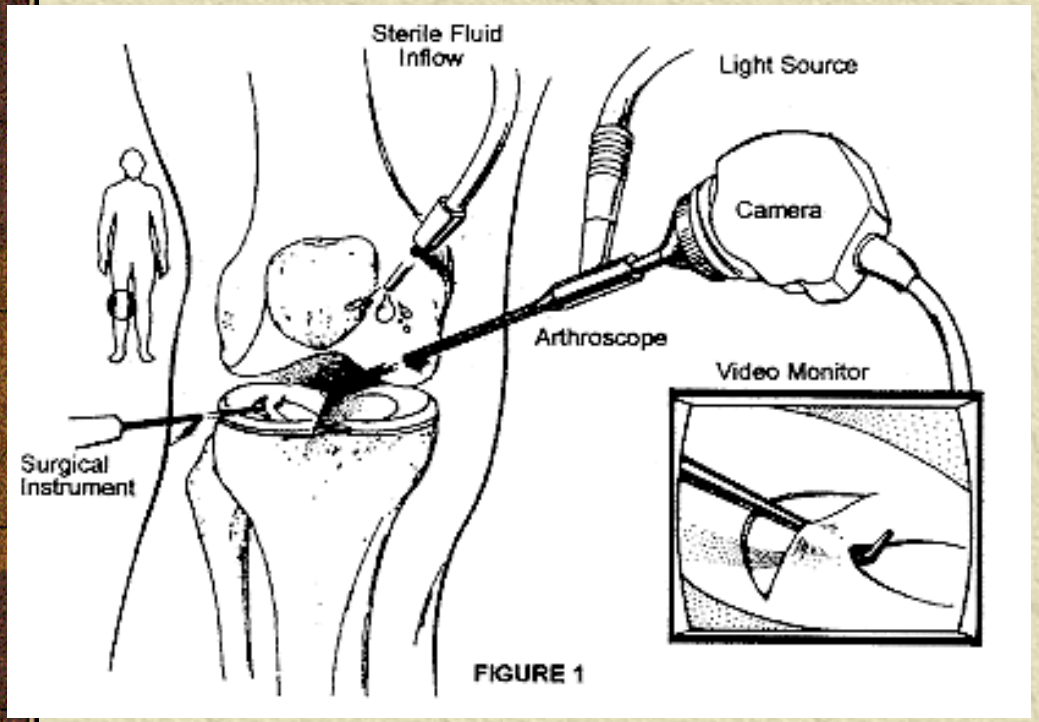
Elbou prosthesis, hip-femur-knees prostesis

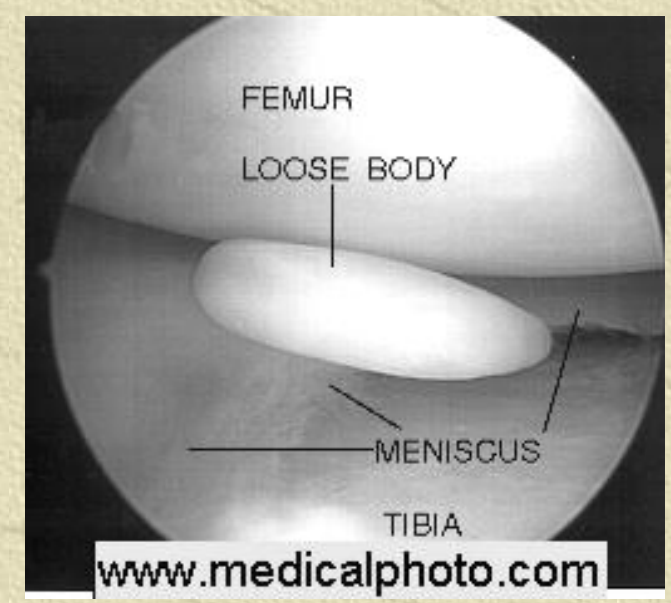


Ankle Joint prosthesis

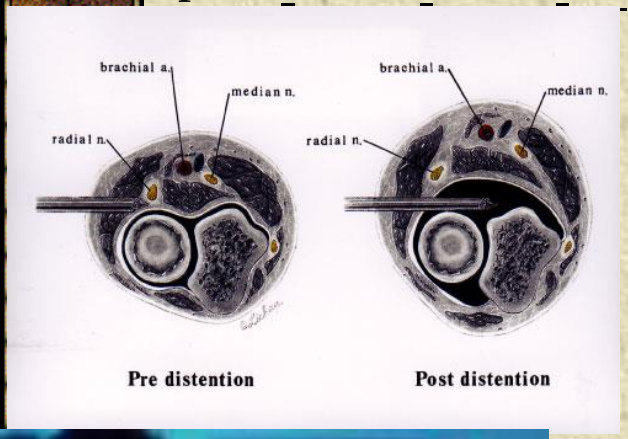
Arthroscopy

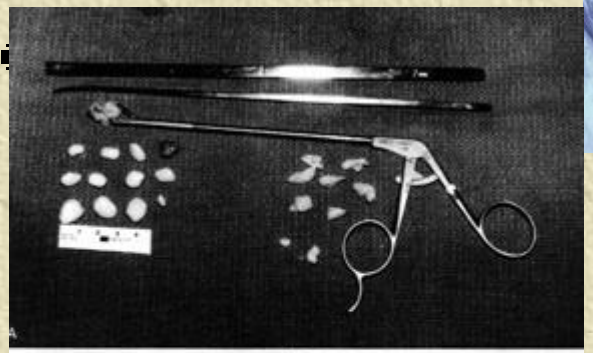
Surgical access on the hip and knee. The artrhoscope is introdused into the the knee joint through a small stab incision and allows examination of structure inside the knee without major surgical exploration.

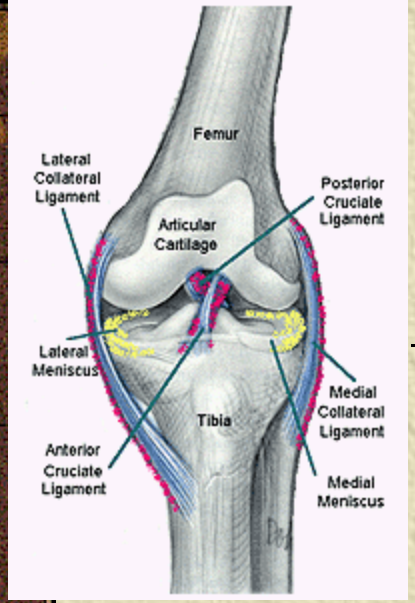


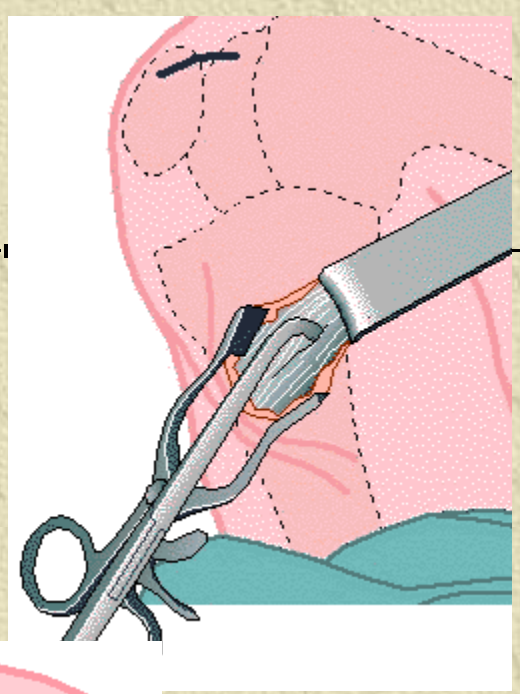


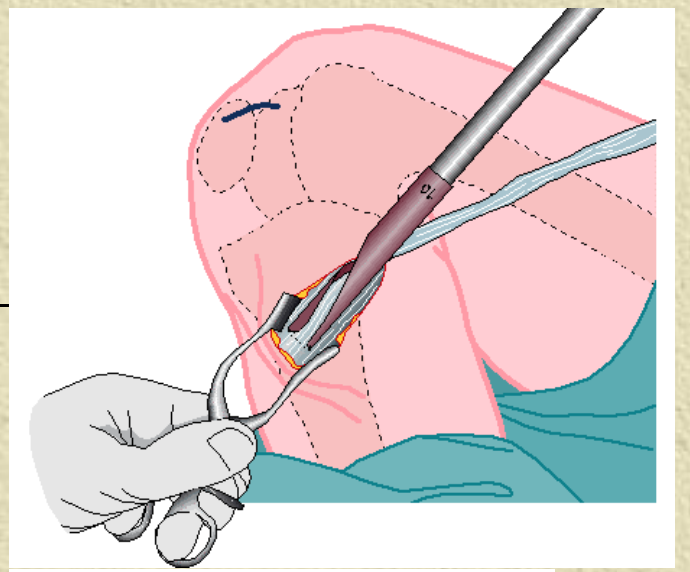
Surgical procedures such as meniscectomy, synovial biopsy, or removal of loose bodies can be performed through the arthroscope with minimal postoperative morbidity compared to open procedures.

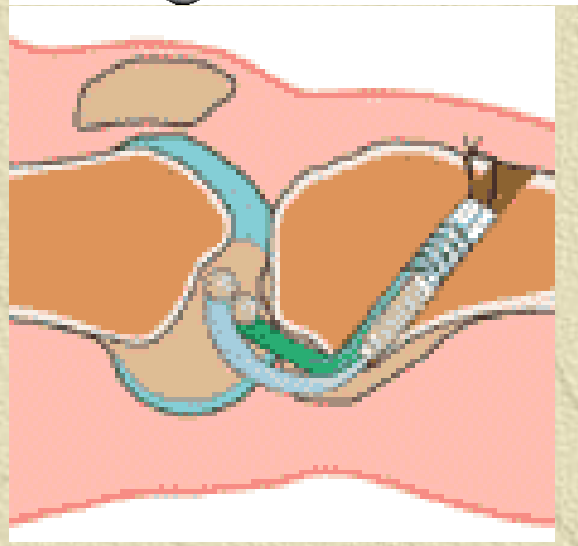


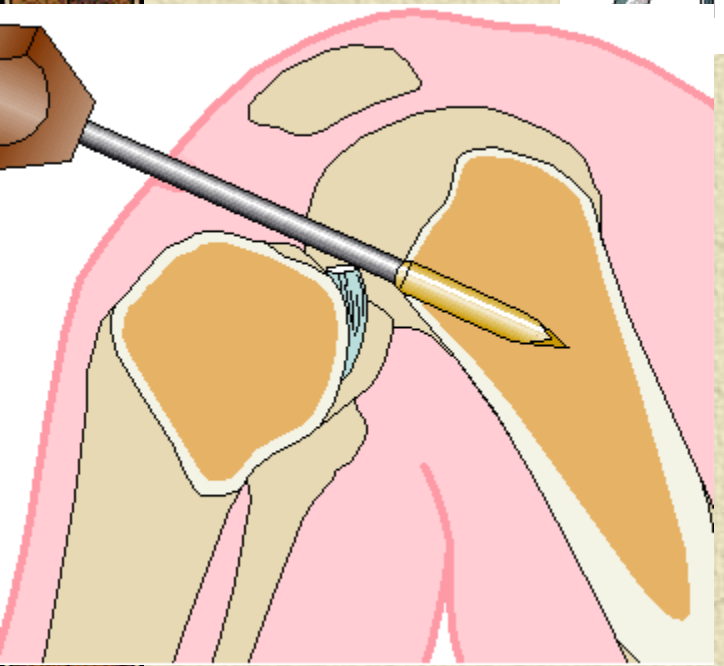


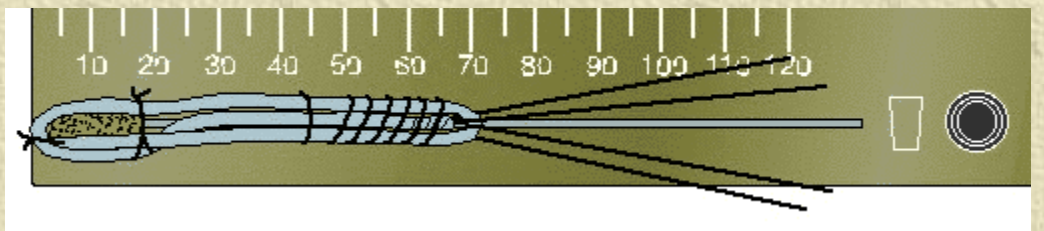

Femur
Lateral Collateral Ligament
Posterior Cruciate Ligament
Articular Cartilage
Lateral Meniscus
Medial Collateral Ligament
Tibia
Anterior Cruciate Ligament
Medial Meniscus







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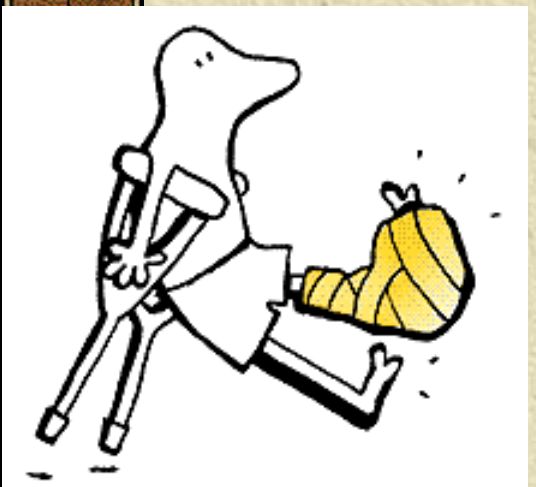
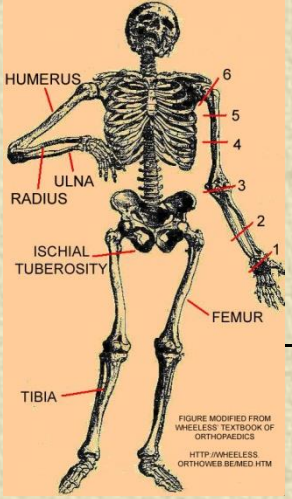
Joint resection – partial and total





Amputation and dezarticulation

PhD, MD, MPH, professor Viorel Nacu
Chişinău

The Amputation is a very ancient surgical PROCEDURE - it was used by Hipocrat (on century IV before Christ).

Lorrei en 1812 had been made about 200 amputation per day, but it was a very higher death rate around 85%, as the result of bleeding, of the shock and infective gangrene.

Now mortality rates have progressively declined in the past decade to about 5-10% for lower extremity amputations.

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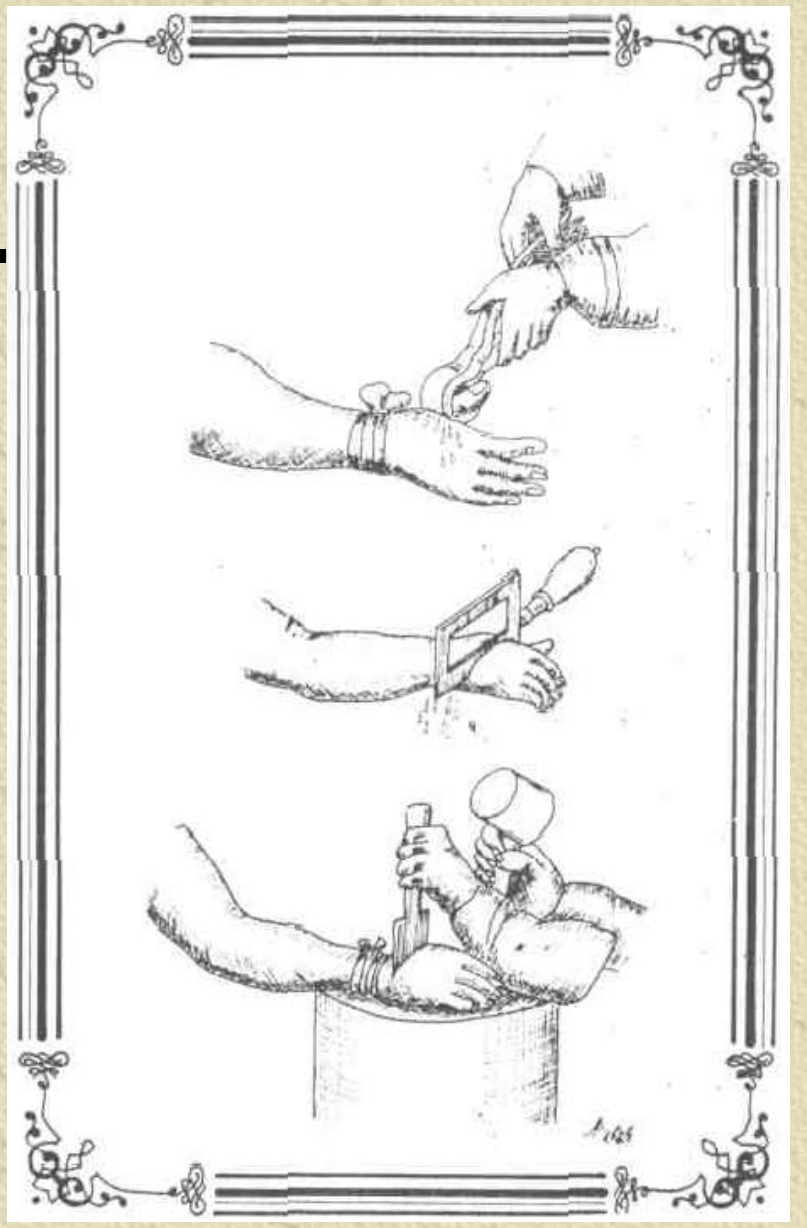


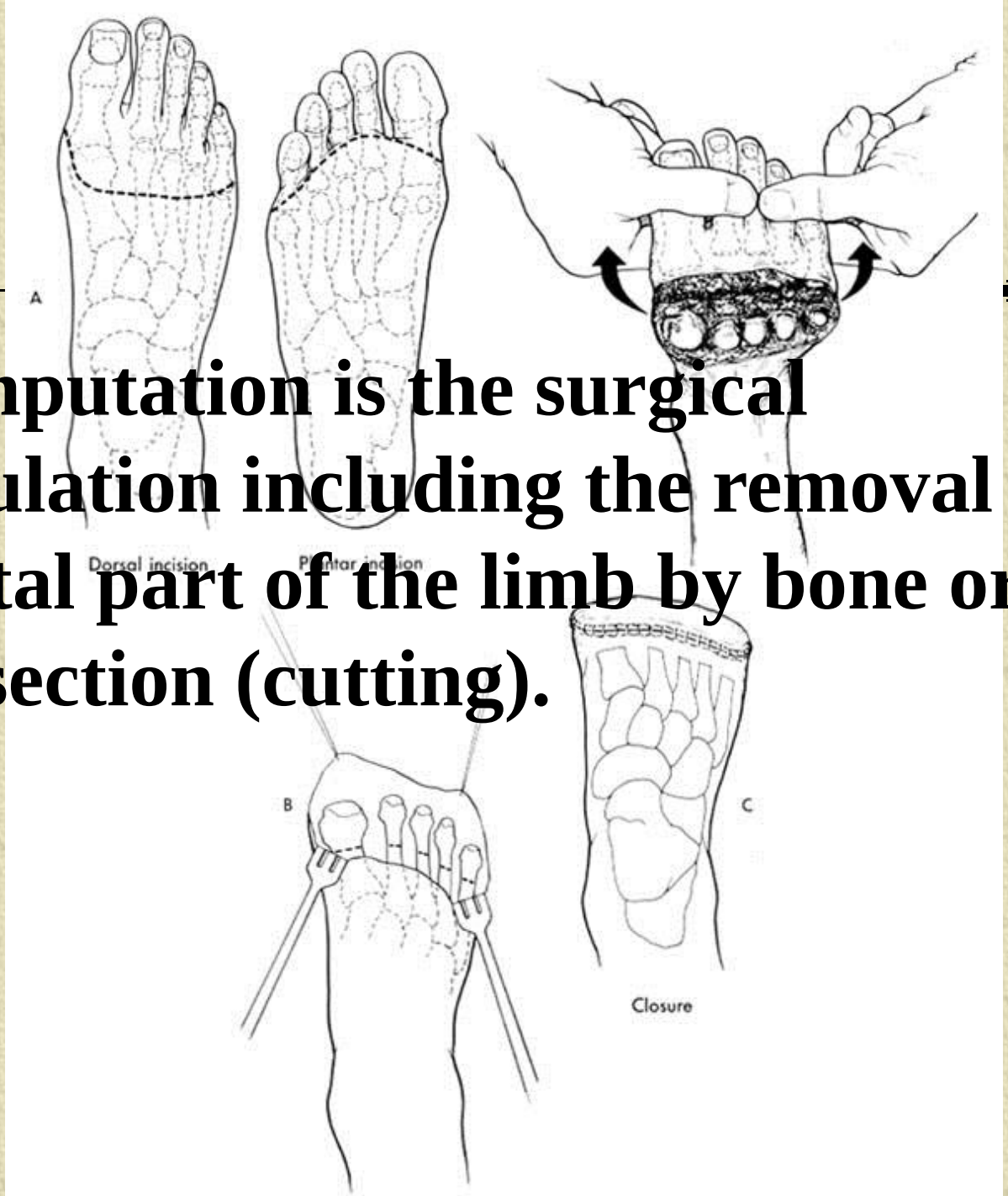
•In the United States there are approximately 150000 amputations performed annually.

•an estimated 2.5 million amputees living in North America alone.

• Ischemia from vascular disease, usually as complications from diabetes, is the most common cause of amputation. Only 3% of the U.S. population is afflicted by diabetes, however diabetics make up 51% of the total amputations performed annually.

•The other 50 % of amputations are caused by massive trauma, infection, or tumors. These causes are more frequent in people under the age of 45.

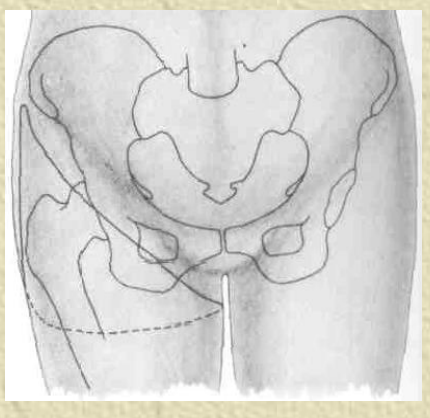
•50 % of the estimated amputees in North America are between the ages of 21 and 65.

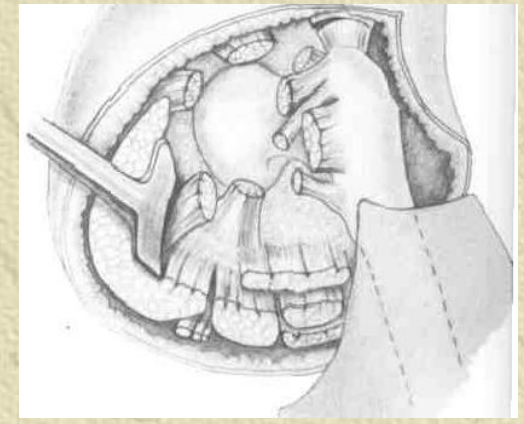


The amputation is the surgical manipulation including the removal of the distal part of the limb by bone or bones section (cutting).

Disarticulations is removal of the distal part of the limb through the articulation without bone section.

Disarticulation in the Lisfranc articulation





Dezarticulation in the coxo-femurale articulation

The goal of the ampu
disarticulation is to s
life.

The indication:

1.ischemic or infective gangrene,
2.diabetes mellitus,
3. trauma,

4. Osteomyelitis,
5. Anaerobic infections,
6. Tumors,
7. Frostbite.

8. Naturopathic ulceration

Upper limb amputations can be:

- Digital
- Forearm
- Through elbow
- Above elbow
- Forequarter

Lower limb amputations can be of the:

- Toe
- Transmetatarsal
- Syme's
- Below knee
- Through knee / Gritty-Stokes
- Above knee
- Hindquarter (hemipelvectomy)

Reamputation - in case of the disease progress or in the vicious stump what can not be prosthesed.

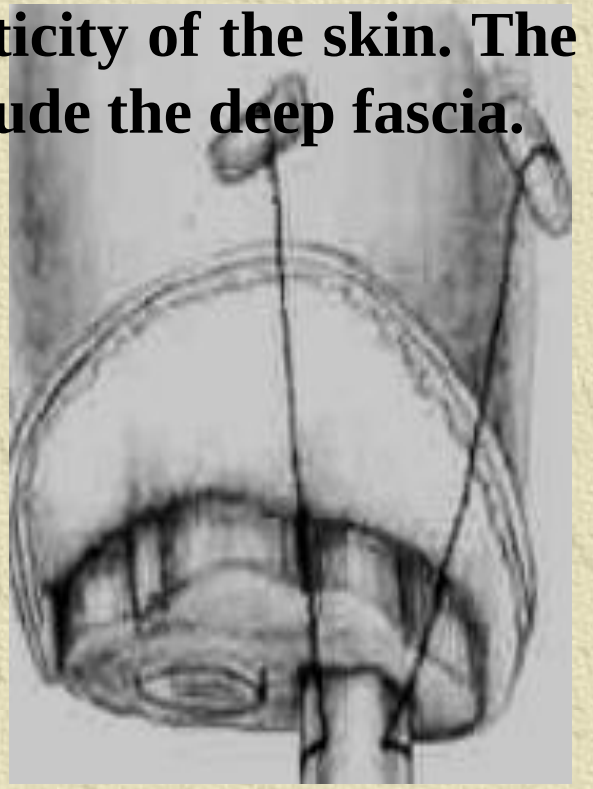
The amputation include 3 steps:

- I. The cutting of the soft tissue;
- II. The cutting of the bone;
- III. The ligature of the vessels, the nerve cutting, haemostasis and stump forming.

Forearm amputation

- **Equal dorsal and volar skin flaps are marked out with their bases at the junction of the middle and lower thirds of the ulna**

- **Otherwise the flaps, after being cut, are drawn into an oblique position by the natural elasticity of the skin. The skin flaps of the first incision should include the deep fascia.**



AMPUTATIONS

- Indications-
  - Gangrenous
  - Non salvageable limb

Evaluation of the Patients who need Amputation
1. Haematocrit,
2.control of anaemia by transfusing blood/ packed cells.
3.Control of infection using antibiotics.
4.Decision of level of amputation by skin temperature, arterial Doppler.
5.Informed consent should be taken.
6.Plan for prosthesis and rehabilitation by physiotherapist and rehabilitation team.

1. Ray's
2. Transmetatarsal (Gillies)
3. Tarsometatarsal (Lisfranc's)
4. Midtarsal (Chopart's)
5. Syme's
6. Below-knee (Burgess)
7. Transcondylar
8. Above-knee

Amputation

- Surgical amputation
- Traumatic amputation
- Levels of amputation
- Complications of amputations: hemorrhage, infection, phantom limb pain, problems associated with immobility, neuroma, flexion contracture.
- Rehabilitation
- Nursing Management

Phantom Limb Pain

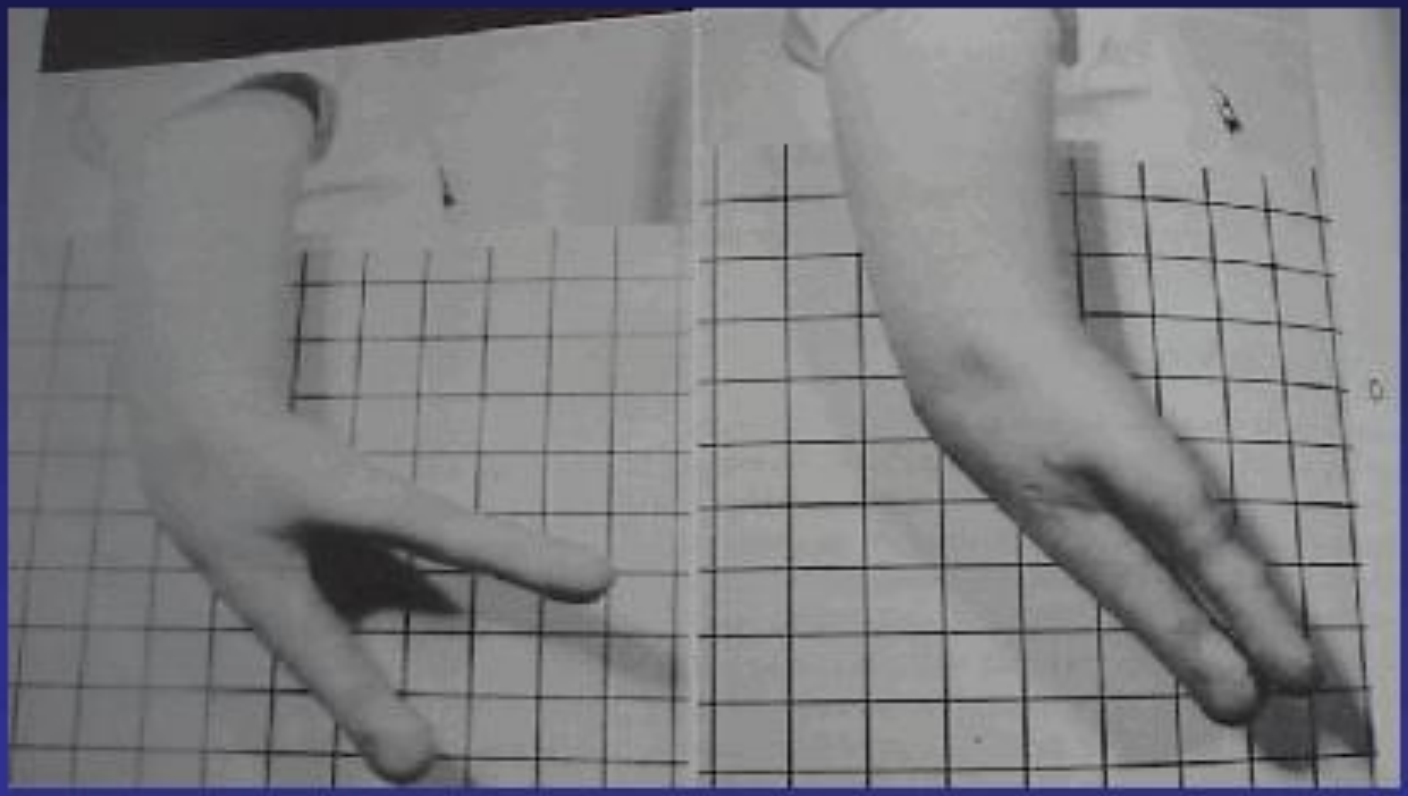
- **Phantom limb pain is a frequent complication of amputation.**
- **Client complains of pain at the site of the removed body part, most often shortly after surgery.**

Prostheses

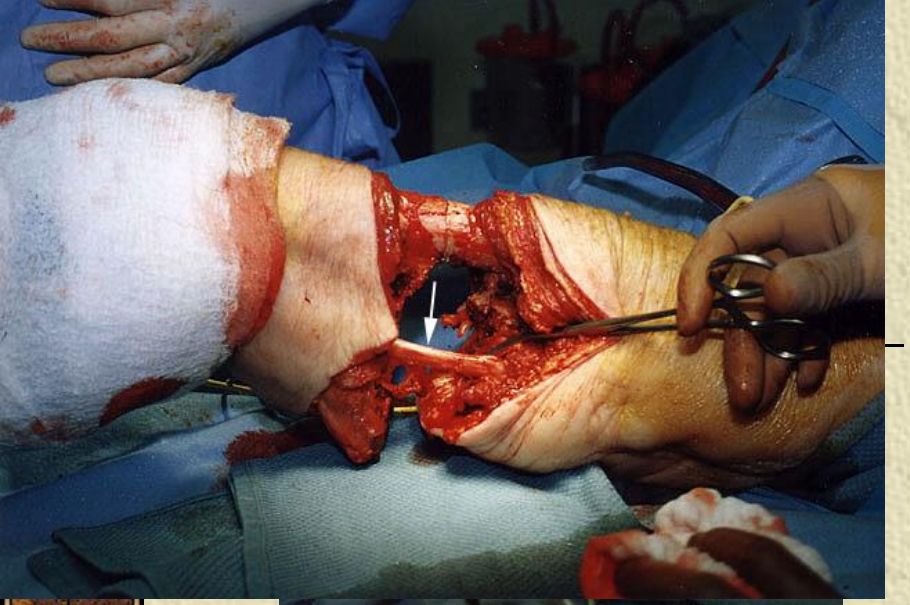
- Devices to help shape and shrink the residual limb and help client readapt
- Wrapping of elastic bandages
- Individual fitting of the prosthesis; special care

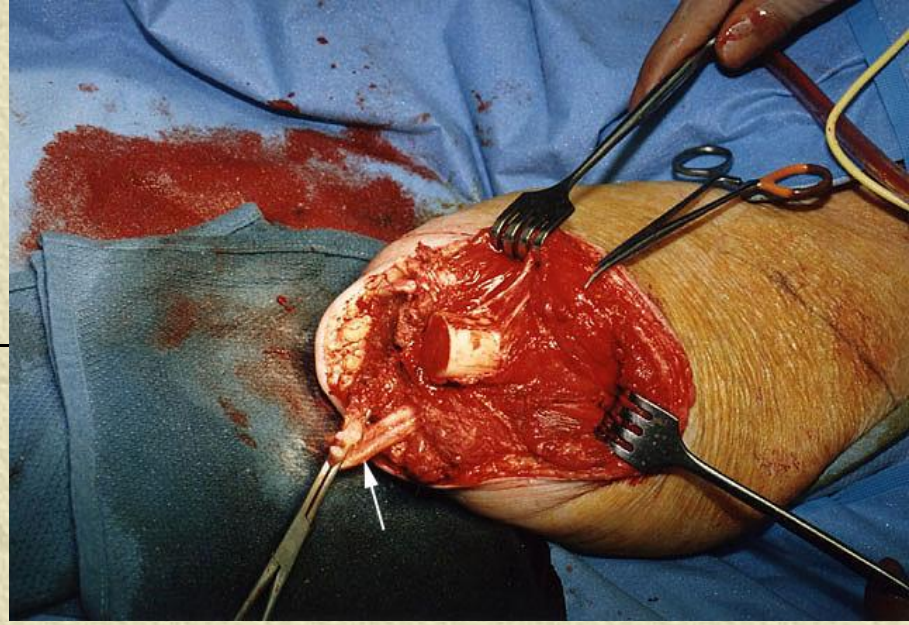
The goal of surgery

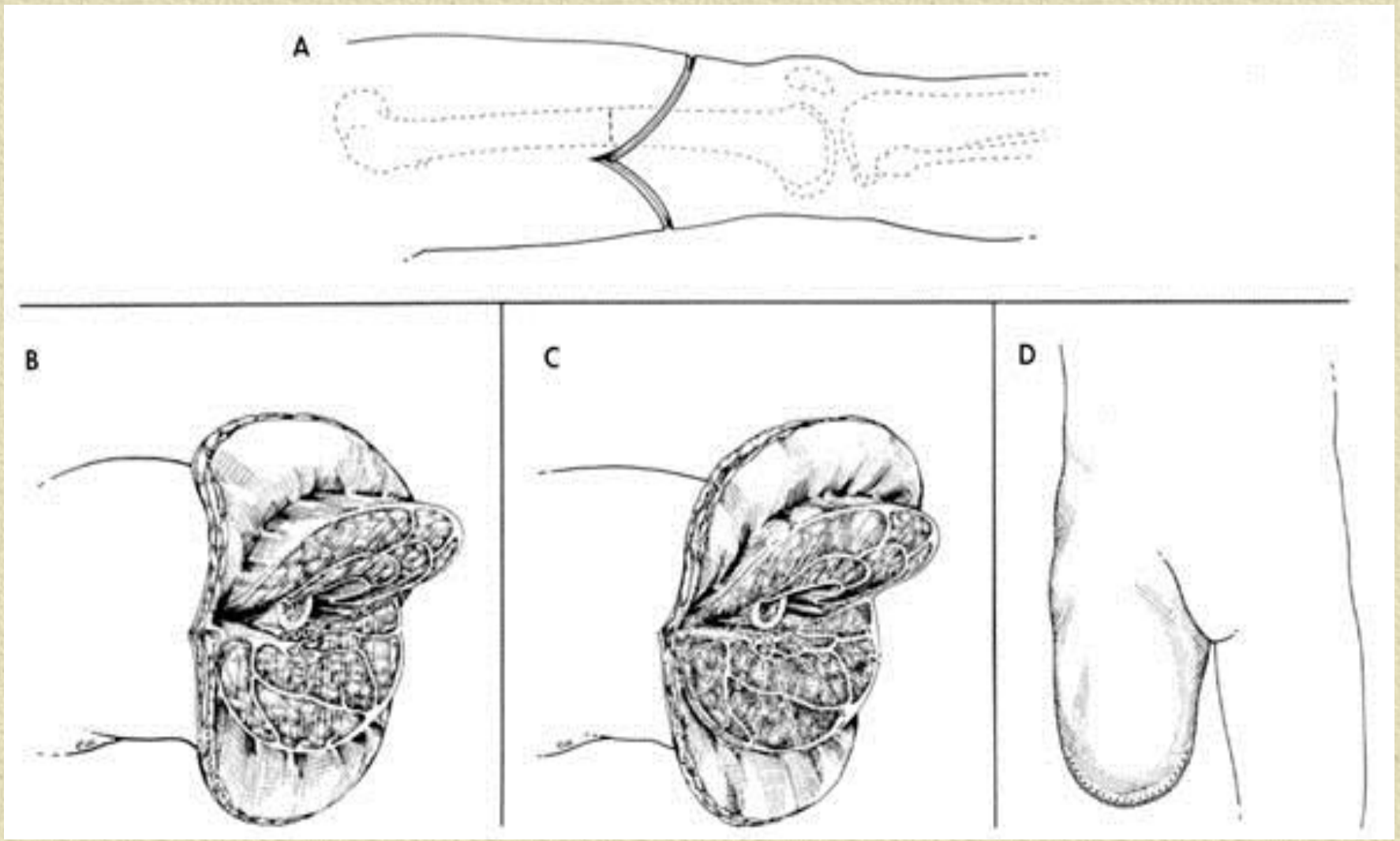
should be the creation of a dynamically balanced residual limb with good motor control and sensation.



The transfemoral amputation involves leaving as much residual limb as possible, preservation of the adductor muscles, and effective suturing of the remaining soft tissue. It has been shown that the length of the residual femur is inversely related to the energy consumption in walking with a prosthesis.






A
B
C
D

MYOPLASTIC ABOVE-KNEE AMPUTATION

The incision

Equal anterior and posterior flaps are marked, their bases being level with the proposed bone section. Their combined lengths should slightly exceed the diameter of the thigh and they should be well rounded in shape rather than pointed. The position of the flaps may have to be adjusted to take account of the scars of previous surgery.

Dissection

The incision is taken down to deep fascia allowing the skin to retract slightly. From the level to which the skin flaps have retracted the muscle is divided with a raking cut that meets the bone precisely at the level of section. The femoral vessels are encountered beneath the sartorius muscle and these should be divided between clamps and doubly legated. The deeper posterior muscles and the profounds vessels are conveniently dealt with after cutting the bone.

Bone section

The periosteum is divided circumferentially at the same point in order to prevent it from being stripped, and the bone is cutted with a Gigli saw.

The sciatic nerve is gently pulled down and its epineurium is held with forceps while the arterial nerve ischiadici is caught and legated. The anesthetic solution is injected under epineurium, after that the nerve cutting is provided 5-6 cm above the bone end.

Haemostasis is secured.

The cutted end of the femoral bone is rounded with a rasp and a slight bevel is produced over the anterolateral aspect.

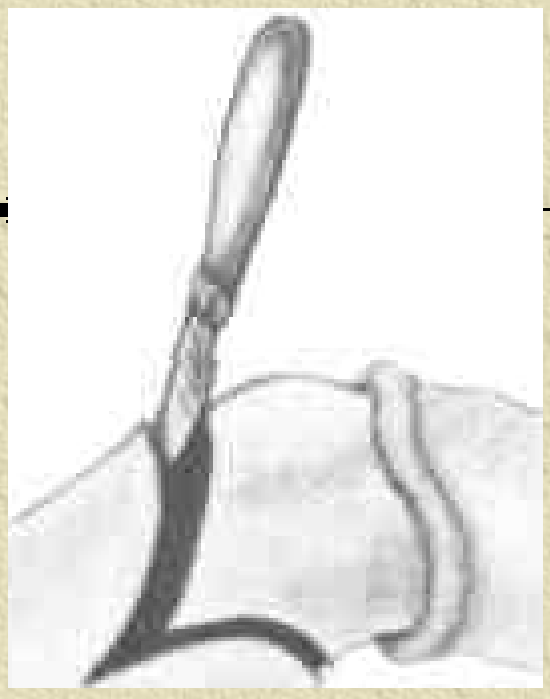
The Amputation can be:

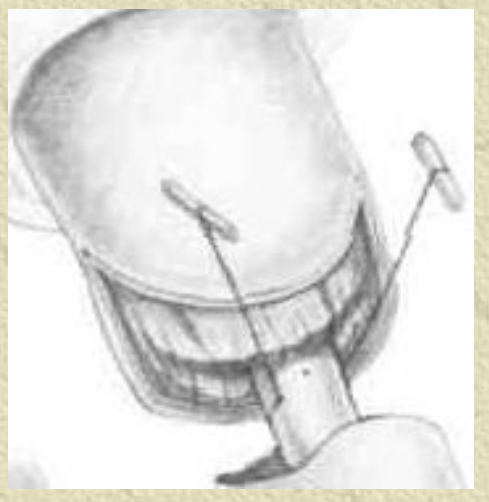
a) With one flap

b) With two flaps.

By the structure, the flaps can be:

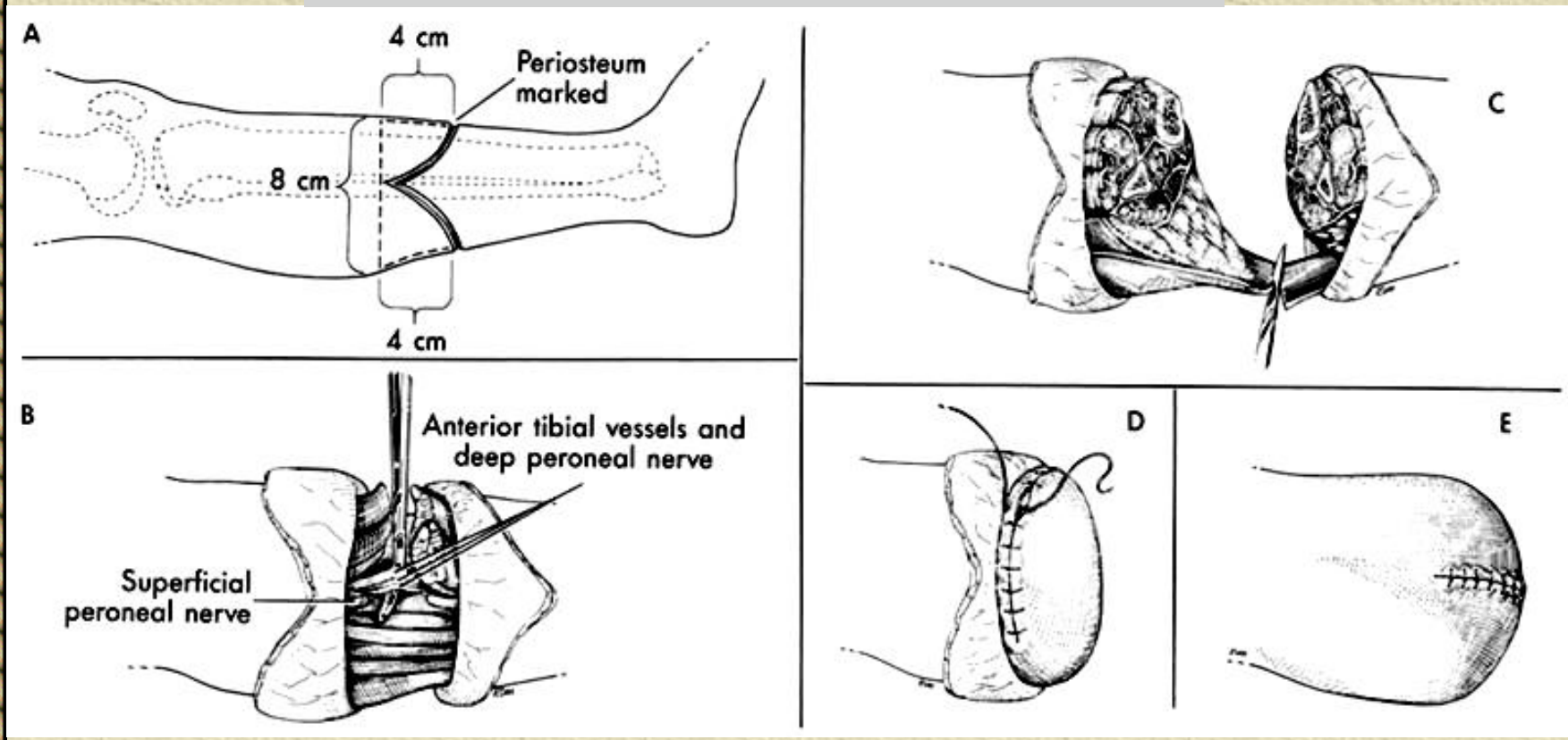
1. fascioplastic;
2. tendoplastic;
3. mioplastic (suture of the antagonists muscles);
4. periostoplastic;
5. Osteoplastice (the Syme)





Below-knee amputation

Most surgeons will create a muscular flap using the gastrocnemius and soleus muscles. These muscles are essentially wrapped under the remaining tibia and secured to the anterior tibia by suture.


A
4 cm
Periosteum marked
8 cm
4 cm
B
Anterior tibial vessels and deep peroneal nerve
Superficial peroneal nerve
C
D
E

Level of Amputation is Influenced by:

1. Cosmetic appearance;
2. Functional requirement;
3. Comfort ;
4. Viability of soft tissues

Amputation should be performed at the level at which healing is most likely to be complete. But which will also permit the most efficient use of the limb following rehabilitation and ease in walking that can be achieved with a distal amputation.

As long a limb as possible should be preserved, in order to maintain the most nearly normal ambulation with the least energy expenditure.

Compared with normal walking, energy expenditure is increased 10-49% with a below/knee prosthesis, 50-70% with an above-knee prosthesis, and 60% with crutches.

Numerous reports in the literature have established that the success of rehabilitation after amputation is directly related to the level of limb loss. At least 90% of patients with below-the-knee amputations will successfully use a prosthesis, in contrast to a success rate of 25% or fewer of those with above-the-knee amputations.

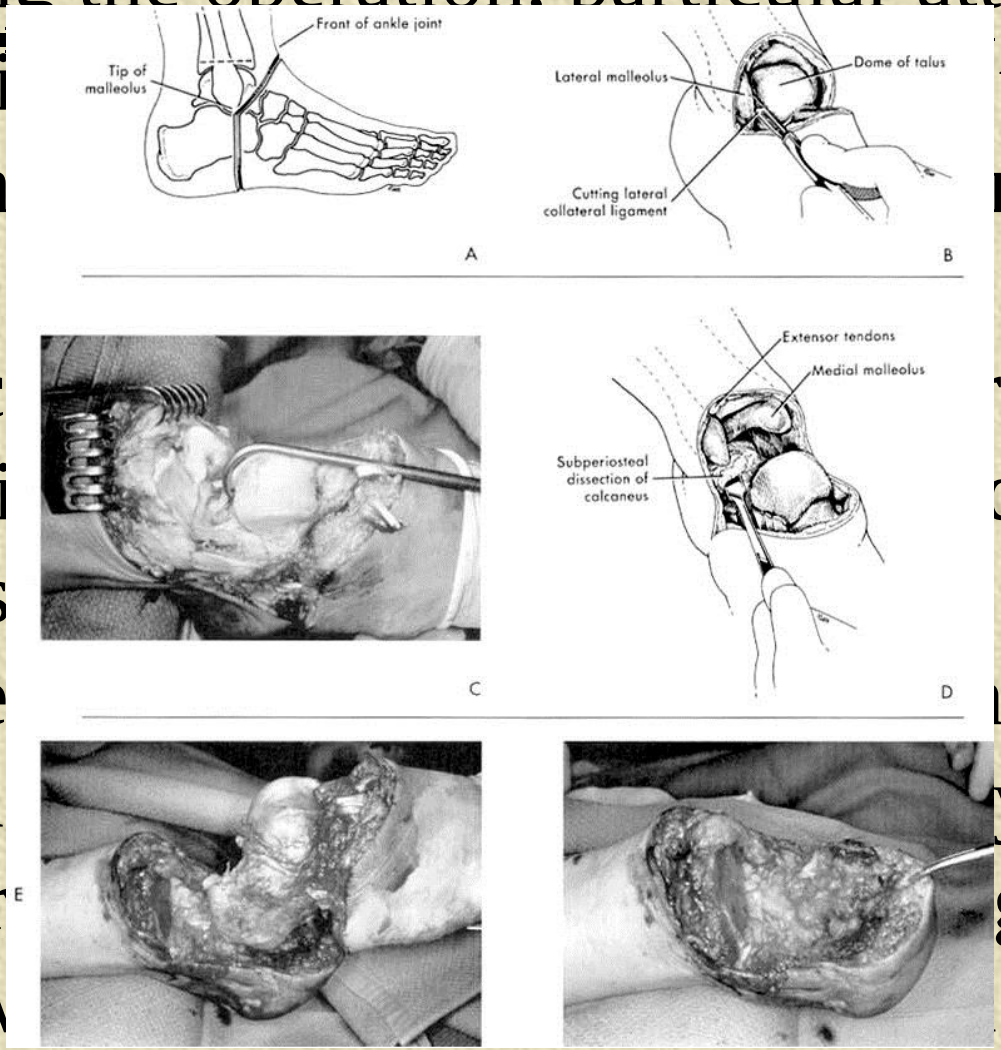
Although
several factors are responsible for this marked variance, the primary factor is the marked increase in energy required to ambulate with an above-the-knee prosthesis when compared with that of a Syme or below-the-knee prosthesis. It is obviously desirable to perform amputations of the lower limb at the distal most level possible if success in rehabilitation is to be achieved.

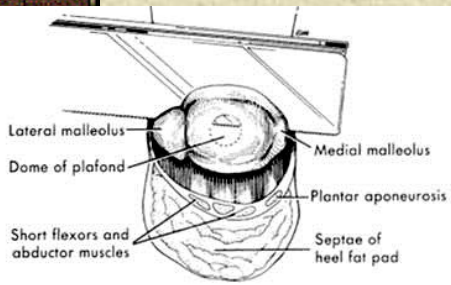
The Syme's amputation

During the operation, particular attention must be pai tibial vessels, wh nferior margins of

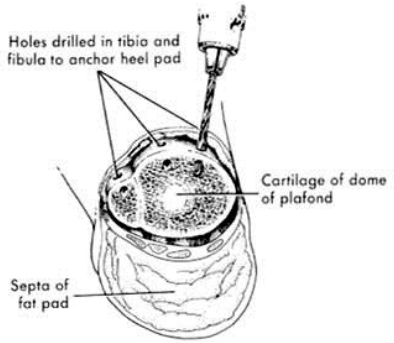
The c om the heel pad wi d injury to the soft tiss

Syme d-bearing strump and y several inches shor g the patient to w prosthesis.

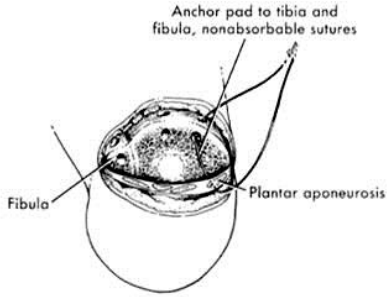



Lateral malleolus
Medial malleolus
Dome of plafond
Plantar aponeurosis
Short flexors and abductor muscles
Septae of heel fat pad

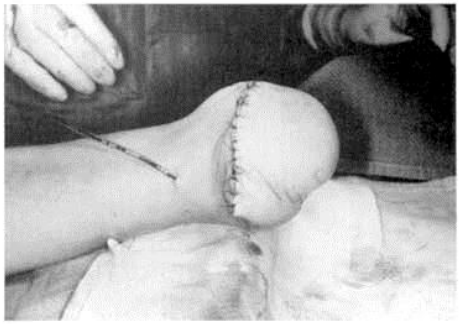
G


Holes drilled in tibia and fibula to anchor heel pad
Cartilage of dome of plafond
Septa of fat pad

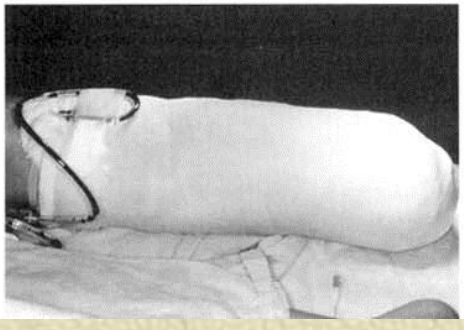
H


Anchor pad to tibia and fibula, nonabsorbable sutures
Fibula
Plantar aponeurosis

I



J



K

A

B

C

D

The features in amputations on childrens limb

1. Growth of the soft tissues is less then of the bones, this fact bring to formation of the conic stump .

To prevent this it is necessary to create drift of soft tissue above bone, thus considerate the skin contracture at children than at an old person.

Sewing together the antagonists muscles as a prophylactics or the conic stump.

- 2. Pair bones of a leg (shin) and a forearm non-uniformly grow. Outstrips growth the peroneal and radial bones.
- These bones have to be cutting shorter by 3-4 cm then tibial and ulnar bones.

- 3. At children static deformation of bones stump more often is observed.

- 4. Amputation of the lower limb in children results in deformation and atrophies of a corresponding half of basin,
- the amputation of the upper limb results in deformation of a humeral belt, sometimes a curvature of a spine column is also deformed.

Complications of amputation

- **Nonhealing**
- **Infection**
- **skin necrosis**
- **pain and flexion Contracture**
- **Neuroma – in a stump** **can be treate**

anesthetic or excision of the neuroma.

- **Phantom limb pain –**

is the sensation that a painful limb is present after amputation. Hypotheses concerning etiology include the gate theory (loss of sensory input decreases self-sustaining neural activity of the gate causing pain);

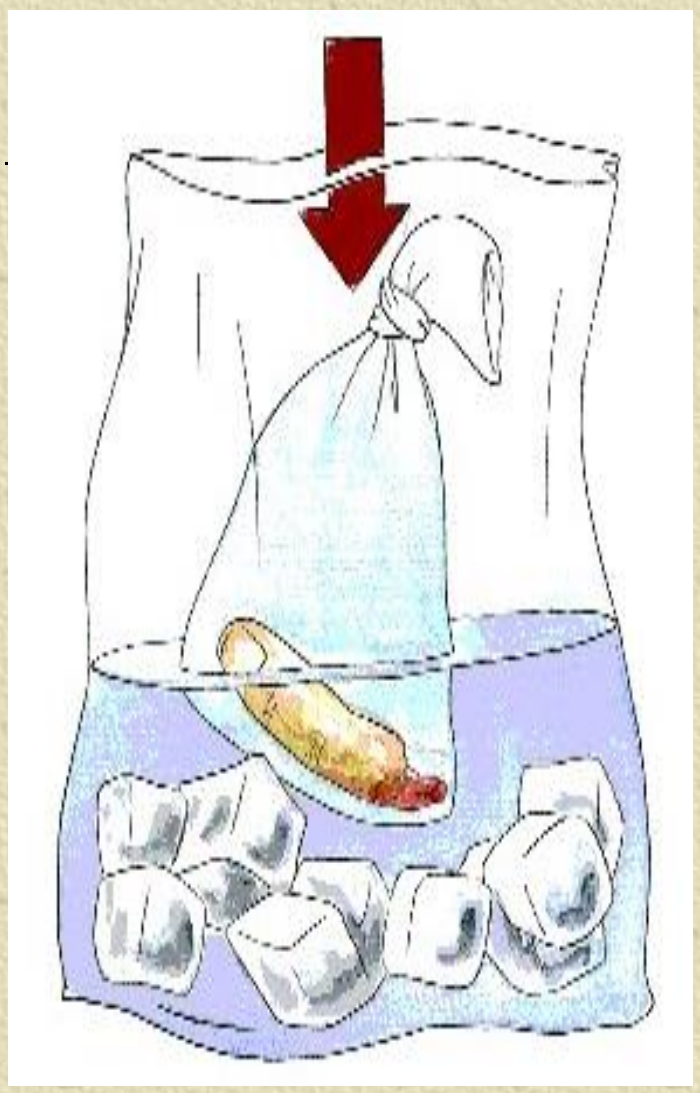
- **the peripheral theory (nerve endings in the stump represent parts originally innervated by the severed nerve); the psychological theory (hostility, guilt and denial are interpreted as pain).**

Microsurgery – techniques now allow previously hopeless cases of traumatic amputation to be treated by replantation.

Function following replantation of the palm, wrist, or forearm, is less satisfactory.

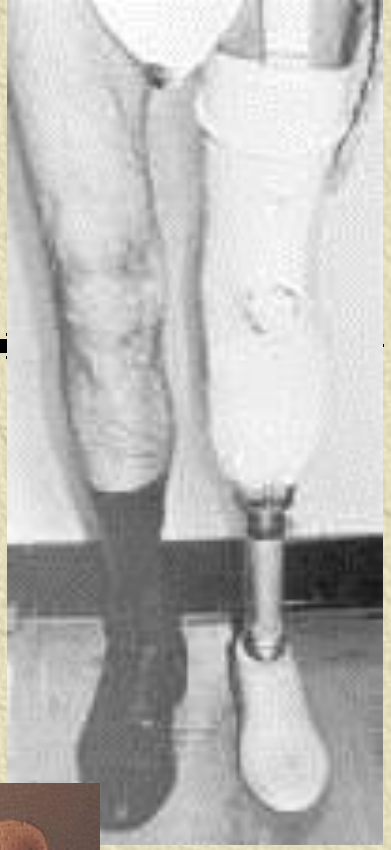
The advantages and disadvantages of amputation and replantation must be weighed:

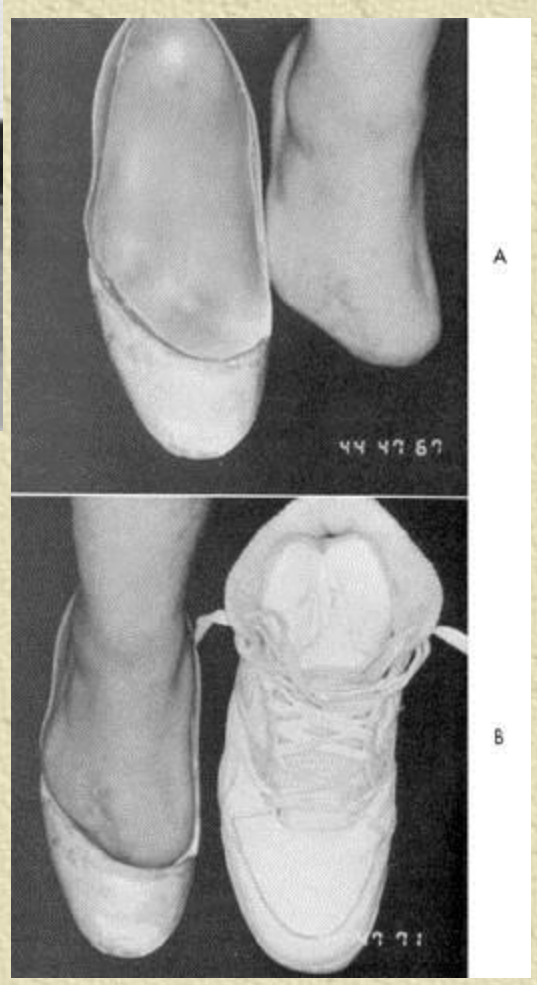
with amputation, there is a cosmetic defect but a relatively short period of rehabilitation; with replantation, there is normal appearance but a long, costly rehabilitation period.

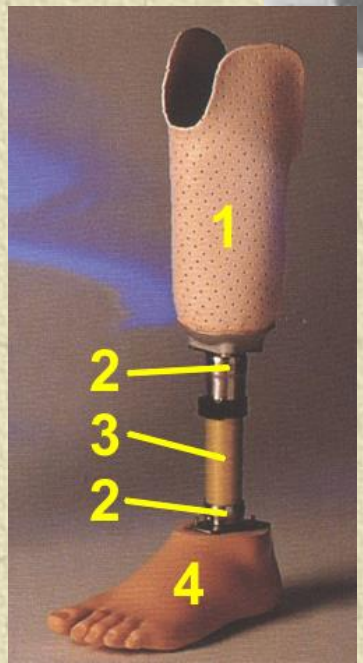


Prosthesis

Modern total-contact prostheses can be fitted satisfactorily on any properly constructed and well-healed lower extremity amputation stump, usually resulting in excellent function.



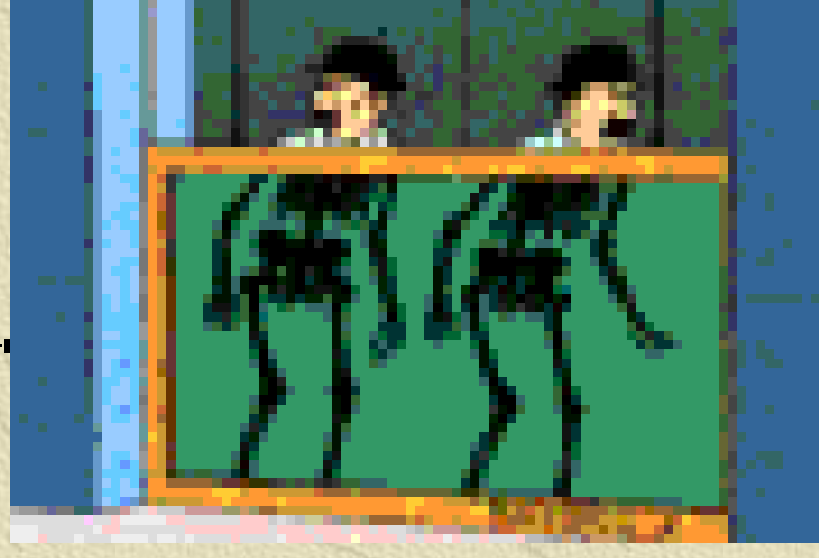

A
B


1
2
3
2
4

Innovations in amputation techniques and in care after surgery, especially the rigid dressing approach and the newer prosthetic techniques, including computer-assisted design and manufacturing of prosthetic sockets, have greatly altered the approach to surgery and rehabilitation. The amputation stump and its prosthesis must assume the walking and weight-bearing functions of the amputated limb.

Burgess has repeatedly pointed out that a strong and dynamic stump must be created that will function as a motor and sensory end organ. His concept of such a stump functioning as a foot like end organ with the prosthesis serving as the “shoe” on this “foot” is exciting and challenging.

Components fashioned from new types of plastics, fiberglass casting tapes and carbon fiber polymers allow construction of ultra lightweight strong and durable prostheses, what permit for young amputees to participate in sports.



Thanks for your attention.