AMPUTATION

By

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“Surgical removal of limb or part of the limb through a bone or multiple bones”

Disarticulation;-

“Surgical removal of hole limb or part of the limb through a joint”

History

Amputation of a leg without anaesthetic, 1593

- Most ancient of surgical procedure.
- Historically were stimulated by the aftermath of war.
- It was a crude procedure - limb was rapidly severed from unanesthetized patient.
- The open stamp was then crushed or dipped in boiling oil to obtain hemostasis.
- Hippocrates was the first to use ligature.
- Ambroise Pare (a France military surgeon) introduced artery forceps. He also designed prosthesis.

INCIDENCE

- Age;- common in 50-75 yrs of age

  traumatic- common in young age

- Sex;- aprox. 75% male

  25% female

- Limb;- aprox. 85% - lower limb

  15% -- upper limb

Indications

Common causes

<50 yrs
. Injury

>50 yrs
peripheral vascular disease

Less common

. Infection(fulminating gas gangrene)
. Malignancy
. Nerve injury
. Congenital anomalies
. miscellaneous

‘

DDD’

- Dead
- Deadly
- Dam Nuisance

Indications: Amputation

TRAUMA

- L/E-≈20-30% of all amputations

  U/E- 77%
- trauma is the leading indication for amputation in younger age group.
- men > women.
- The only absolute indication for primary amputation is an irreparable vascular injury in an ischemic limb.

  Lange absolute indication

  type IIIc with warm ischaemia more than 6hrs
  - **Relative indication**
  - serious associated injuries
  - severe ipsilateral foot injuries

To Remove the limb subjectivity

- predicive salvage index
- limb injury score
- mangled extremity syndrome index
- Attempts to salvage a severely injured limb may lead to metabolic overload and secondary organ failure
- Injury severity score > 50 : contraindication to limb salvage

- **mangled extremity severity score(**M.E.S.S.)(Helfet, CORR, 80, 1990) **(most useful)**

< 7 : Salvage 8-12 : Amputate

Table 1. Mangled Extremity Severity Score (MESS) [11]

Skeletal/soft tissue injury	
	Low energy injury (eg. simple bone fracture) – 1 point
	Medium energy injury (eg. multiple bone fractures) – 2 points
	High energy injury (eg. car accidents) – 3 points
	Very high energy injury (eg. high speed trauma with severe contamination) – 4 points
Limb ischemia	
	Normal perfusion with reduces or even absent pulse – 1*point
	Absent pulse,paresthesia, diminished capillary refill – 2points
	Cool, paralyzed, insensate limb – 3*points
Shock	
	Systolic blood pressure > 90 mm Hg: 0 points
	Hypotensive transiently: 1 point
	Hypotensive persistent: 2 points
Age	
	< 30 years: 0 points
	30-50 years: 1 point
	> 50 years: 2 points

*The score is doubled for ischemia > 6 hours

MESS <= 6 – Limb salvageable

PERIPHERAL VASCULAR DISEASE

L/E 60-70% of amputations

U/E 6%

Arteriosclerosis

Thromboembolism

- +/-diabetes
- Most significant predictor of amputation in diabetes:- peripheral neuropathy
- Infection increases in : -

  S. alb <3.5gm/dl

  WBC < 1500cells/ml
- Prior stroke
- decrease ankle-brachial blood pressure index
- Vascular surgery consultation

Infection

Gas gangrene.

clostridial myonecrosis- within 24 hr.

bronze discoloration

serosanguineous exudates, musty odor

immediate radical debridement

I/V penicillin or clindamycin

Streptococcal myonecrosis- 3-4 days

Anaerobic cellulitis or necrotizing fasciitis

-**Acute or chronic infection** that is unresponsive to

antibiotics and surgical debridement.

- open amputation done

Congenital limb deficiency

- L/E <3% of all amputations

  U/E 9%
- Occurs in ≈1/2000 births
- failure of partial or complete formation of a portion of the limb.
- Congenital extremity deficiencies have been classified as longitudinal, transverse, or intercalary.
- Radial or tibial deficiencies are referred to as preaxial, and
- ulnar and fibular deficiencies are referred to as postaxial

Tumors

- L/E ≈5% of all amputations
  U/E 8%

- Amputation is performed less frequently with the advent of advanced limb-salvage techniques.

BURNS AND FROSTBITE

Burns :-

- delayed aputation – local infection
- - systemic infection
- - myoglobin induced renal failure
- - death

Frostbite :-

Typically occurs when one is trapped in extreme cold conditions for extended periods

- direct tissue injury- ice crystals in ECF
- Ischaemic injury- vascular endothelium
- clot formation
- inc sympathetic tone
- limb kept at 40-44 degree C
- wait 2-6 month demarcation
- Triple phase tecnetium bone scan

TYPES OF AMPUTATION

Open

- Guillotine
- modified guillotine

Closed amputation

- revised
- planned

PATHOPHYSIOLOGY

"The energy required for walking is inversely proportionate to the length of the remaining limb"

- Amputation of the lower extremity is often the treatment of choice for an unreconstructable or a functionally unsatisfactory limb
- The higher the level of a lower-limb amputation, the greater the energy expenditure that is required for walking
- As the level of the amputation moves proximally, the walking speed of the individual decreases, and the oxygen consumption increases

- In transtibial amputations, the energy cost for walking is not much greater than that required for persons who have not undergone amputations.
- For those who have undergone transfemoral amputations, the energy required is 50-65% greater than that required for those who have not undergone amputations .

Lab Studies

- **Hematocrit**
- Creatinine levels should be monitored. In individuals with muscle injury and necrosis, myoglobin enters the systemic circulation and can lead to renal insufficiency and failure. especially in individuals with thermal and electrical burns.

- **Potassium** and **calcium** levels should be monitored. Elevated levels of these electrolytes may lead to cardiac arrhythmias and seizures.
- White blood cell count, C-reactive protein , and ESR Expect the C-reactive protein to be the first laboratory value to respond to treatment,
- **Platelets**

Imaging Studies

- **X-ray AP & Lat view**

- **Computed tomography (CT)** scanning and **magnetic resonance imaging (MRI)** are performed for the patient tumour workup or for osteomyelitis to ensure that the surgical margins are appropriate.

- **Technetium-99m (99mTc)** pyrophosphate bone scanning has been used to predict the need for amputation in persons with electrical burns and frostbite.

  A 94% sensitivity rate and a 100% specificity rate has been reported in demarcating viable tissues from nonviable tissues.

Doppler ultrasonography - measure arterial pressure;

- In approximately 15% of patients with PVD, the results are falsely elevated because of the noncompressibility of the calcified extremity arteries.
- Doppler ultrasonography has been used in the past to predict wound healing.

A minimum measurement of 70 mm Hg is believed to be necessary for wound healing.

Ischemic index (II): -

This index is the ratio of the Doppler ultrasonography pressure at the level being tested to the brachial systolic pressure. An II of 0.5 or greater at the surgical level is necessary to support wound healing.

Ankle-brachial index: -

The II at the ankle level is believed to be the best indicator for assessing adequate inflow to the ischemic limb. An index less than 0.45 indicates incisions distal to the ankle will not heal.

Preoperative preparation includes the following steps: -

- Appropriate preoperative antibiotics
- A tourniquet is placed on the limb prophylactically
- Vascular and bone instruments are requested.
- A series of 45º-angled chisels are obtained for osteomyoplastic reconstruction.
- An appropriate strength saw for cutting bone
- Vessel ligatures are obtained.

General principles for amputation surgery involve appropriate management of skin, bone, nerves, and vessels, as follows: -

– The greatest skin length possible should be maintained for muscle coverage and a tension-free closure.

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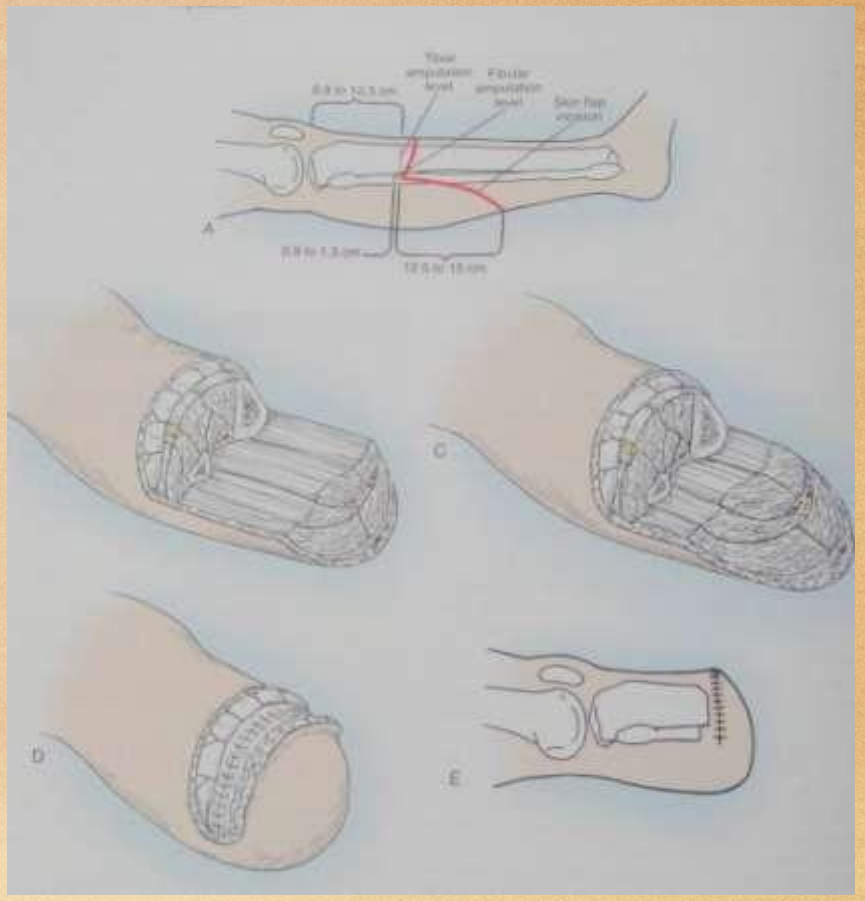
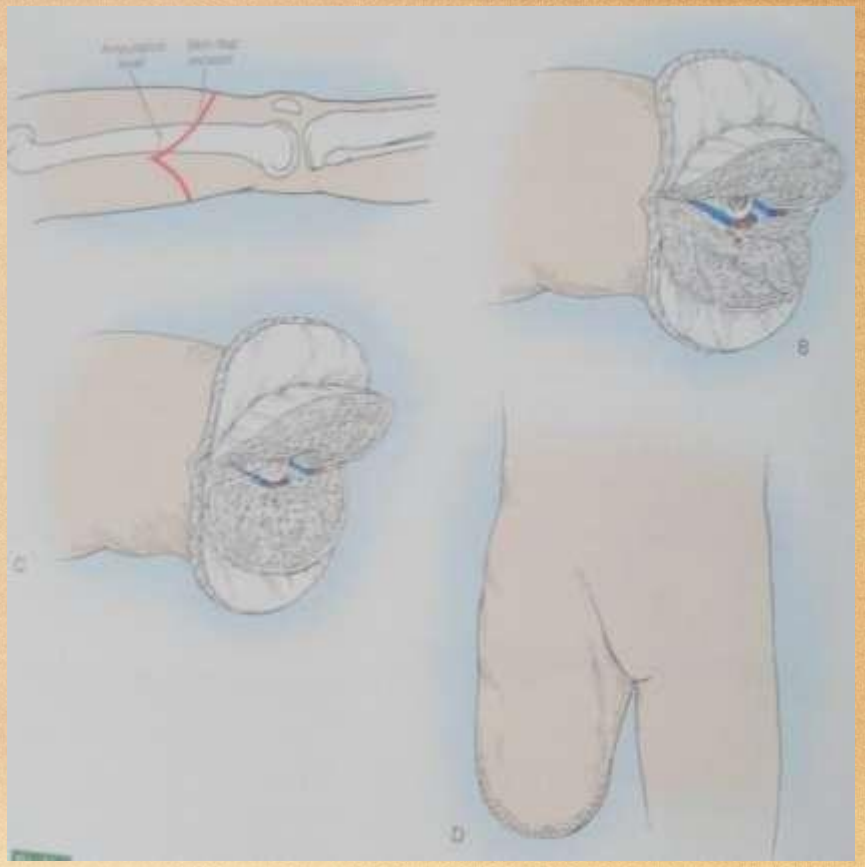
- Muscle is placed over the cut end of bones via a myodesis (ie, muscle sutured through drill holes in bone), a long posterior flap sutured anteriorly, or a well-balanced myoplasty (ie, antagonistic muscle and fascia groups sutured together).



- Nerves are transected under tension, proximal to the cut end of bones in a scar- and tension-free environment. Ligation of large nerves can be performed when an associated vessel is present.



- The larger arteries and veins are dissected and separately ligated. This prevents the development of arteriovenous fistulas and aneurysms.
- Bony prominences around disarticulations are removed with a saw and filed smooth. Diaphyseal transections can be covered with a local flexible osteoperiosteal graft. Maintaining the maximal extremity length possible is desirable. However, below-knee amputations are best performed 12.5-17.5 cm below the joint line for nonischemic limbs
- **One application guide is to make a limb 2.5 cm long for every 30 cm of body height for upper limb.** For ischemic limbs, a higher level of 10-12.5 cm below the joint line is used because making limbs longer than this can interfere with prosthetic use and design

Standard surgical principles for amputation in the child

- Preserve the physis.
- Amputations through the metaphysis (such as above-knee or distal forearm level) or diaphysis are not recommended in children because of the progressive relative shortening of the residual limb. This is most critical in the femur, but it is applicable to other long bones as well.
- Disarticulate when possible. Disarticulation completely eliminates the problem of terminal overgrowth and subsequent revision surgery.

– Preserve stump shape. The pediatric amputation stump becomes conical with growth, so preservation of bony architecture such as a short segment of proximal fibula or the distal condyles of the humerus will assist in subsequent rotational control of the prosthesis.

The split-thickness skin graft can hypertrophy and become sufficiently strong to withstand the shear forces of prosthesis use.

Precautions

- Close attention to soft tissue techniques.
- Avoid unnecessary dissection between skin and subcutaneous, fascial & muscle plane.
- In adult periosteum should not be stripped proximal to the level of transection .
- In children 0.5cm removal of distal periosteum prevents terminal growth .

Goals of Postoperative Management

- Prompt, uncomplicated wound healing
- Control of edema
- Control of Postoperative pain
- Prevention of joint contractures
- Rapid rehabilitation

Post operative: -

- **Rigid dressing** : decreses edema, decreases post operative pain, protect limb from trauma, early mobilsation.
- Cast to be appied at the end of the procedure, changed on the post op day 5 + IPOP
- Cast changed weekly

- **In postoperative prosthesis** : early training with an IPOP is believed to increase the long term acceptance and use of prosthesis
- New prosthesis around 18 months
- regular check-ups every 3-6 months for the next two years.
- Two weeks after surgery, muscle-contraction exercises and progressive desensitization of the residual extremity are initiated.

- Desensitization is started with a towel for distal residual extremity pressure, and distal-end bearing is started on a soft structure (usually a bed).

Care of the Stump

- keep the stump clean, dry, and free from infection at all times.
- If fitted with a prosthesis, you should remove it before going to sleep.
- Inspect and wash the stump with mild soap and warm water every night, then dry thoroughly and apply talcum powder.
- do not use the prosthesis until the skin has healed.
- The stump sock should be changed daily, and the inside of the socket may be cleaned with mild soap.

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UP TO 2/3 OF AMPUTEES WILL MANIFEST POSTOPERATIVE PSYCHIATRIC SYMPTOMS

- Depression
- Anxiety
- Crying spells
- Insomnia
- Loss of appetite
- Suicidal ideation

Rehabilitations

- 1. Residual Limb Shrinkage and Shaping
- 2. Limb Desensitization
- 3. Maintain joint range of motion
- 4. Strengthen residual limb
- 5. Maximize Self reliance
- 6. Patient education: Future goals and prosthetic options

Complications

Risk factors for complications includes

- Blood clotting disorder
- Diabetes
- Anemia
- Certain medication, such as steroids
- Infection
- Obesity

hematoma

1. **Failure of wound to heal :-** gap if wider than 1cm needs revision
   - **2.Infection :** -open – flaps retract / edematous results in shortening the bone

     Rx

     close only central 1/3 for coverage of bone.
   - **3. Phantom limb sensation :-** diminishes over time, telescoping
   - **4. Pain and phantom pain : -**massage , cold packs, exercise and neuromuscular stimulation

     -TENS (trans cutaneous electric nerve stimulation) : incorporated in a prosthesis

     -carbamazipine,Phenytoin,gabapentin,Amitriptylin &Mexiletine

     - Preioperative analgesia can prevent or decrease the later incidence of phantom pain.

5. Edema

- mistakes :- 1) Too tightly applied cast
- 2) Soft spica cast – not applied in Transfemoral cast
- -Proximal constriction
- management -Elevation

6. Joint contacture

7. **Deep vein thrombosis**

Some special type of amputation

- **Dupuytren's amputation ;-** amputation of the arm at the shoulder joint.
  - elliptic amputation one in which the cut has an elliptical outline.
- **Gritti-Stokes amputation ;-** amputation of the leg through the knee, using an oval anterior flap.

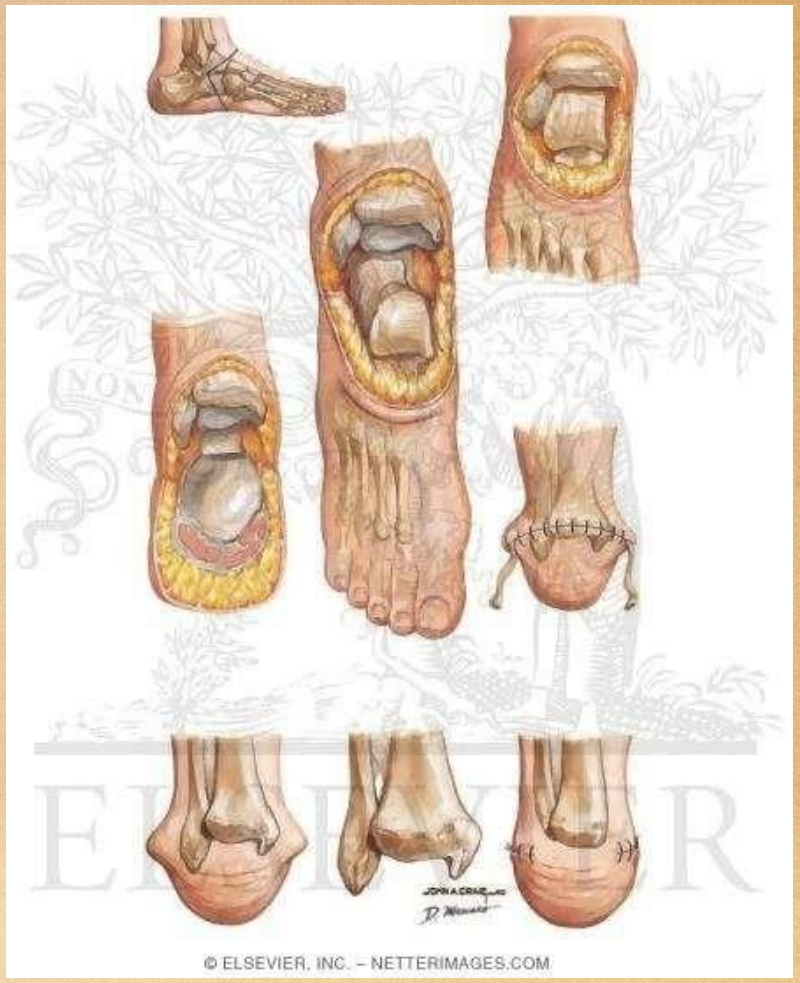
- **Hey's amputation ;-** amputation of the foot between the tarsus and metatarsus.
- **interpelviabdominal amputation ;-** amputation of the thigh with excision of the lateral half of the pelvis.
- **interscapulothoracic amputation ;-** amputation of the arm with excision of the lateral portion of the shoulder girdle.
- **Larrey's amputation;-** amputation at the shoulder joint.

- **spontaneous amputation;-** loss of a part without surgical intervention, as in diabetes mellitus

  - **Sarmiento's amputation-** level is 1.3 cms proximal to ankle joint line.
  - **Teale's amputation;-** amputation with short and long rectangular flaps.

Syme's amputation

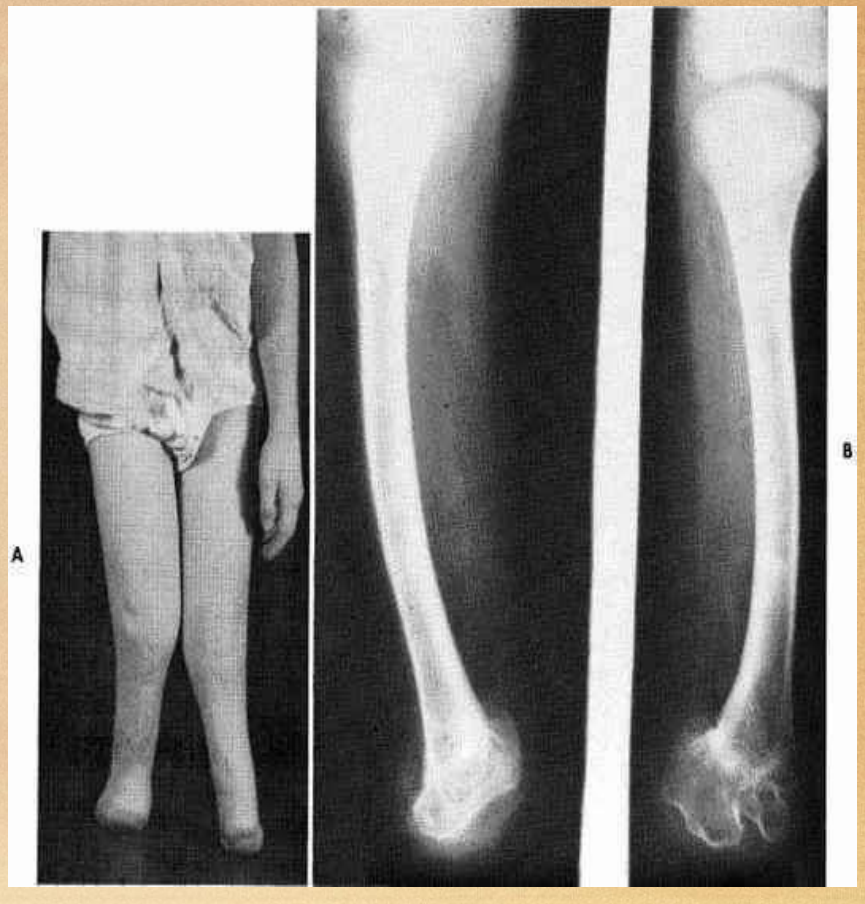
- disarticulation of the foot with removal of both malleoli 0.6 cms proximal to joint line.
- amputation provides an end-bearing stump that in many circumstances allows ambulation without a prosthesis over short distances.
- It is an excellent amputation for children, in whom it preserves the physes at the distal end of the tibia and fibula



BOYD's AMPUTATION

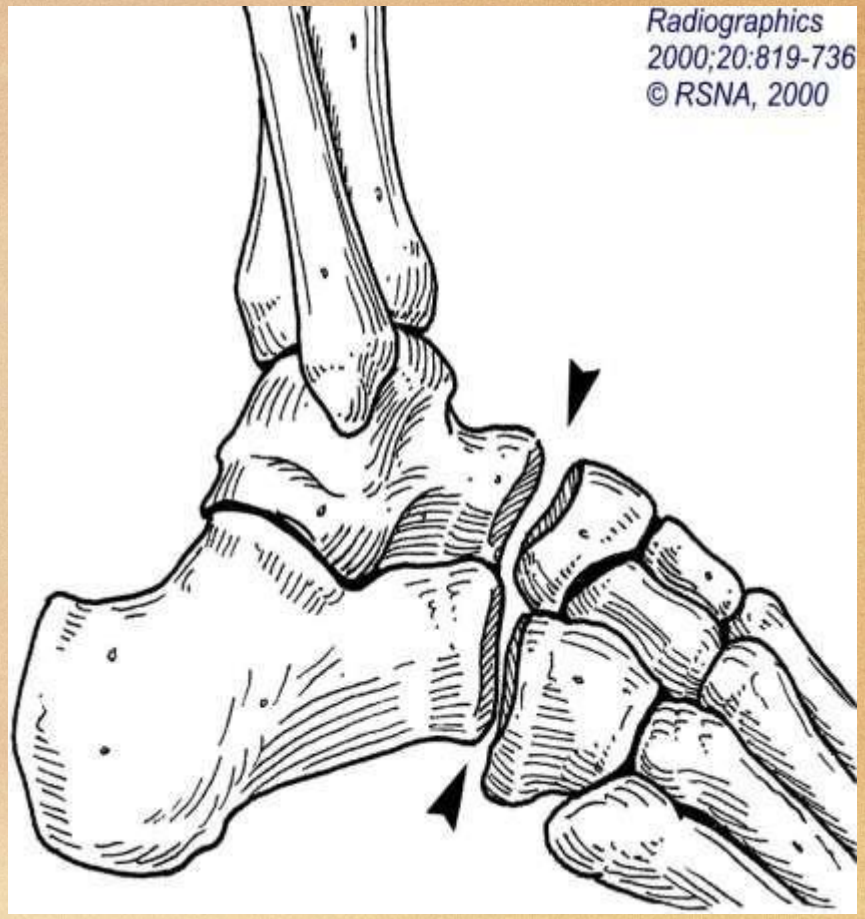
- The Boyd procedure provides a broad weight-bearing surface of the heel by creating an arthrodesis between the distal tibia and the tuber of the calcaneus after talectomy

- Compared to a Syme's amputation, it provides more length and better preserves the weight-bearing function of the heel pad.



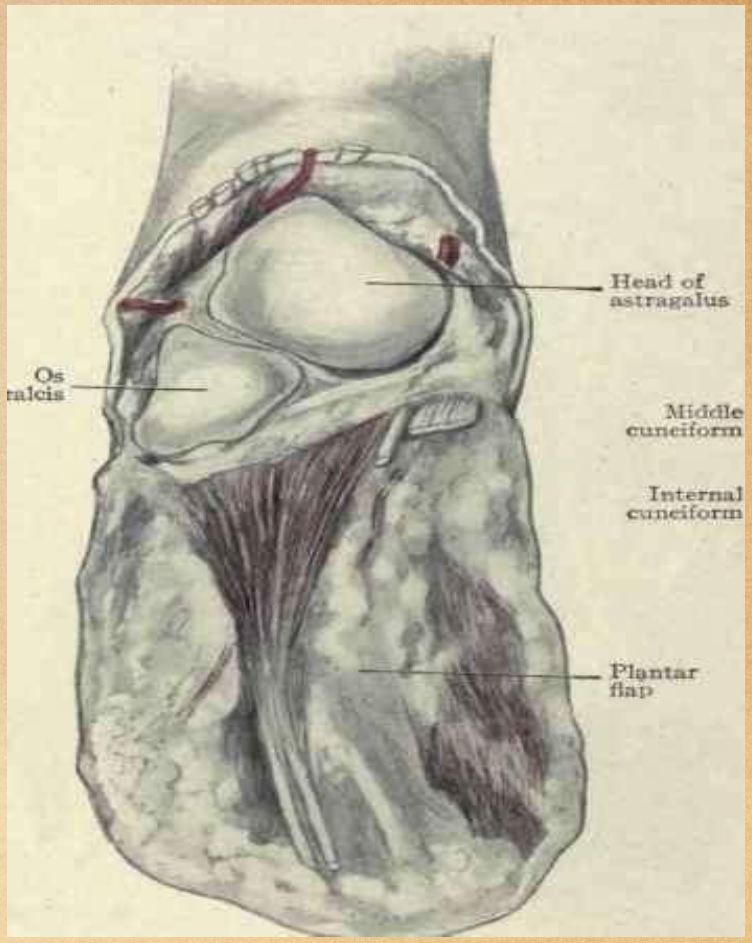
CHOPART AMPUTATION

amputation of the foot by a midtarsal disarticulation.



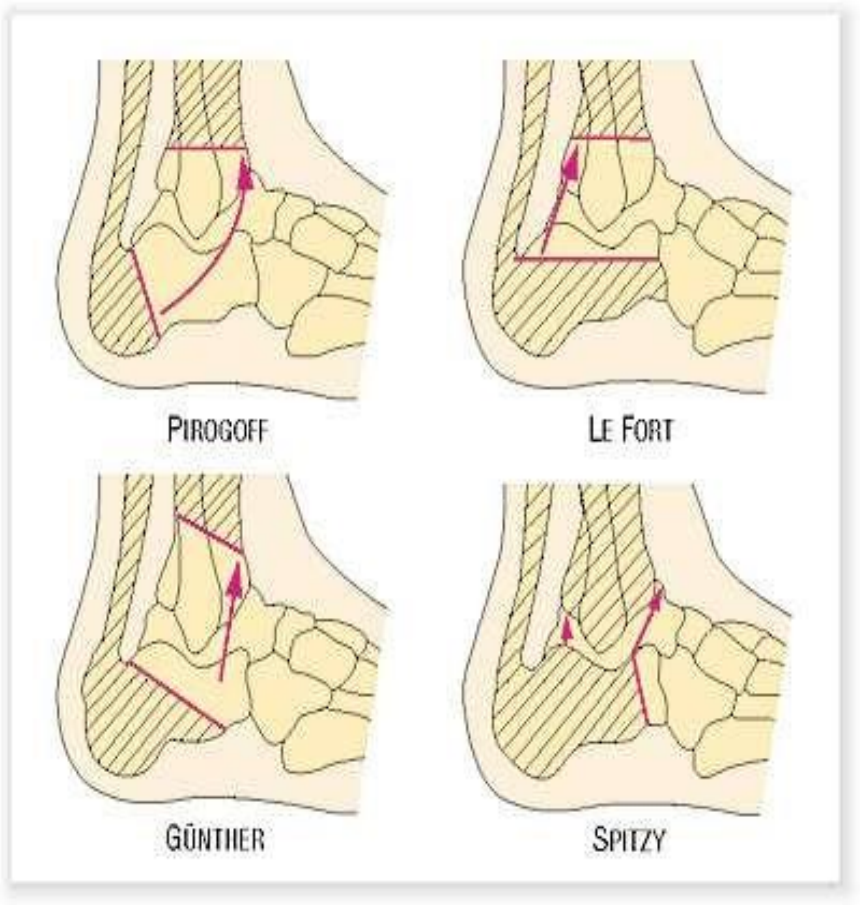
LISFRANC AMPUTATION

amputation of the foot between the metatarsus and tarsus.



Pirogoff amputation

amputation of the foot at the ankle, part of the calcaneus being left in the stump.



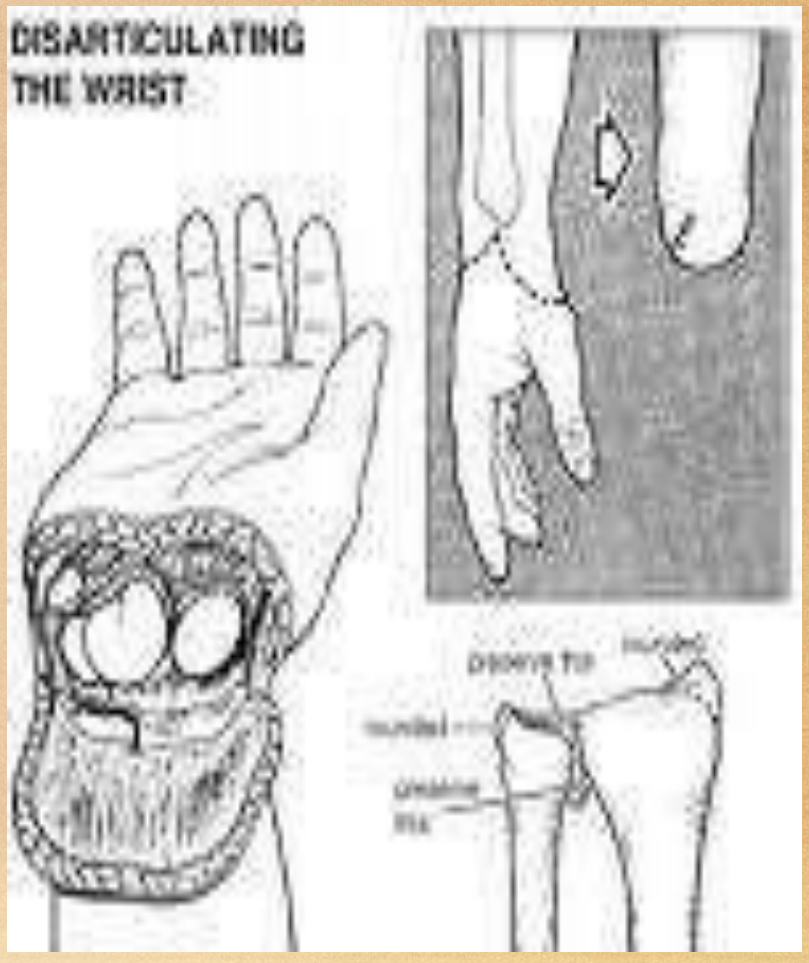
- ***Transcarpal amputation ;-***

  - At this level, supination and pronation of the forearm, as well as flexion and extension of the wrist,
  - Ideally, a long full-thickness palmar and shorter dorsal flap should be created in a ratio of 2:1.
  - Finger flexor and extensor tendons should be drawn, divided, and allowed to retract deep into the proximal wound. Conversely, wrist flexor and extensor tendons are identified and released from their distal insertions and reflected proximally out of the way.
    - The wrist flexors and extensors should be anchored to the remaining carpus in line with their insertions to preserve active wrist motion

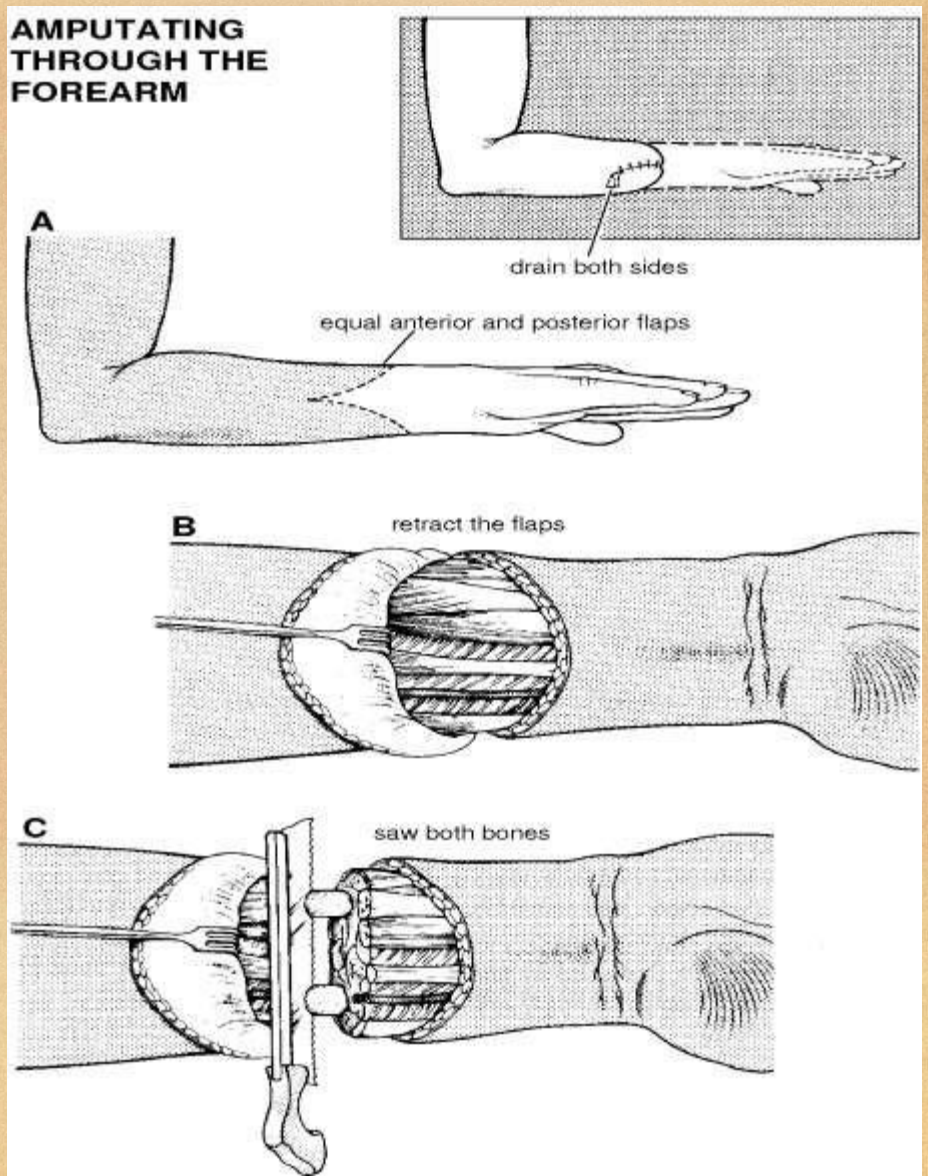
Wrist disarticulation ;-

- providing a long lever arm and preserved supination and pronation.

- a technique to minimize postoperative pain from neuroma formation, which involves extending the incisions proximally between the pronator teres and brachioradialis just distal to the elbow flexion crease and doubly ligating the median, ulnar, and superficial radial nerves at this level.
  - Preserving the triangular fibrocartilage ,shortening of the radial styloid should be avoided that improves prosthetic suspension
  - procedure of choice in children

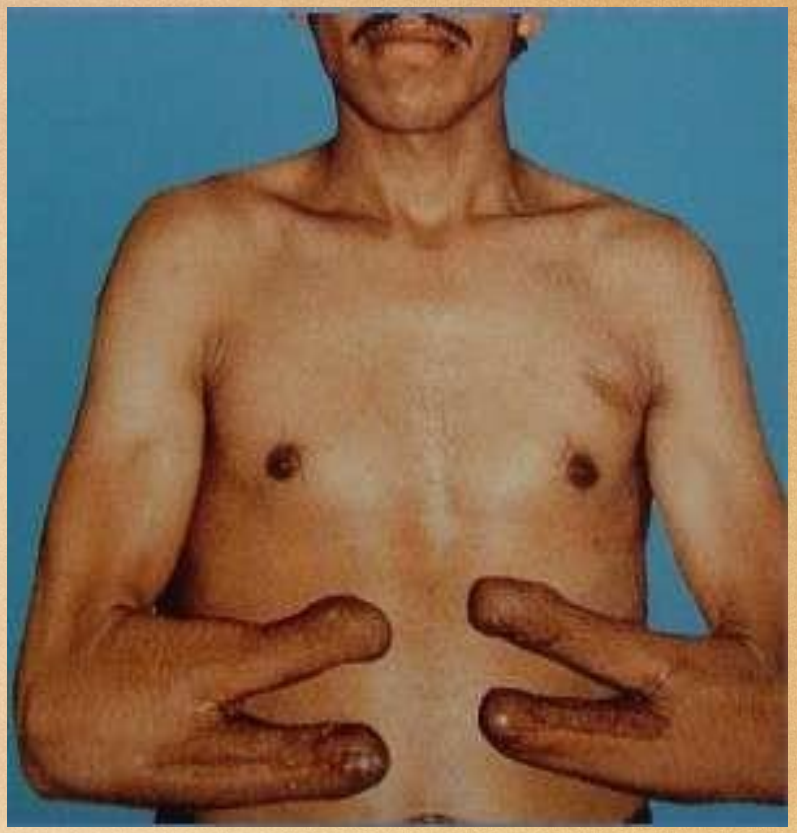


Forearm amputation



KRUKENBERG PROCEDURE ;-

- More than 80 years ago, Krukenberg described a technique that converts a forearm stump into a pincer that is motorized by the pronator teres muscle. Indications for this procedure have been debated; however, they generally include bilateral upper-extremity amputations, in those who are also blind.
- not recommended as a primary procedure at the time of an amputation,
- To consider this surgical option, the ulna and radius must extend distal to the majority of the pronator teres (the motor for pinching) and an elbow flexion contracture of less than 70°.



PROSTHESIS

IT IS A REPLACEMENT OF SUBSTITUTION OF A MISSING OR A DISEASED PART

CLASSIFICATION

ENDOPROSTHESIS-
IMPLANTS USED IN
ORTHOPAEDIC SURGERY eg;
AUSTIN MOORE
PROSTHESIS

EXOPROSTHESIS-EXTERNAL
REPLACEMENT FOR
A LOST PART OF THE LIMB

PROSTHESIS FOR LOWER LIMB

1FOR DISARTICULATION OF HIP AND HEMIPELVECTOMY

2FOR TRANSFEMORAL AMPUTATION

SUCTION SOCKETED

.2 WAY VALVE MECHANISM

NEGATIVE PRESSURE

.SNUGGLY FITS

.USEUL IN YOUNG PT.

.BEST FOR CILINDRICAL STUMPS

NON SUCTION SOCKETED- PELVIC BANDS IN PLACE OF NEGATIVE PRESSURE TO HOLD

CAMPARISON FOR SUCTION SOCKETED PROSTHESIS WITH NON SUCTION SOCKETED

SUCION SOCKETED	NON SUCTION SOCKETED
-LESS SKIN INFECTION	-MORE INCIDENCE OF SKIN INFECTION
-FEEL OF CLOSE CONTACT WITH PROSTHESIS	-NOT SO
-SOCKS ARE NOT NECESSSARY	-NECESSARY
-NOT EASY TO WEAR	-EASY TO WEAR
-LESS COMFORTABLE	-MORE COMFORTABLE

PROSTHESIS FOR BELOW KNEE AMPUTATION

PTB PROSTHESIS-

SOCKET FITS EXACTLY OVER THE PATELLAR TENDON AND TIBIAL CONDYLES

Bilateral below-knee amputation and exoskeletal below-knee resin prosthesis.

CONVENTIONAL TYPE PROSTHESIS-

CONSISTS OF

-THIGH CORSET

-SIDE STEELS

- KNEE JOINT

-SHIN PIECE

-ANKLE JOINT

-FOOT PIECE

PROSTHSIS FOR SYME'S AMPUTATION

-HAVE CLOSE SOCKETS OR OPEN SOCKETS

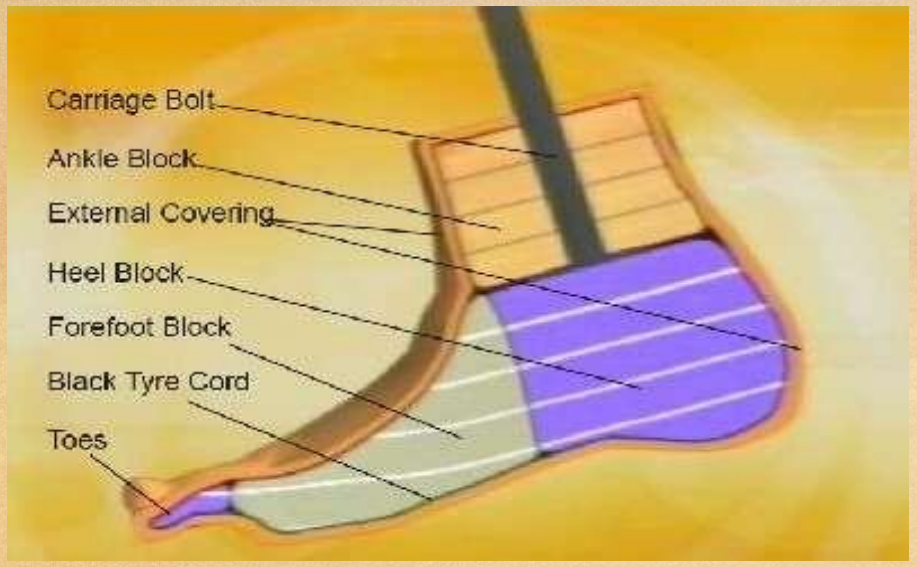
-FULL WIEGHHT BEARING OR MODIFIED END BEARING

SACH(SOLID ACTION CUSHION HEEL) FOOT

-WHOLE FOOT IS OF VARIOUS LAYERS OF RUBBER WITH VARYING DENSITY
-NO ANKLE JOINT
-ABOVE ACTION ACHIEVED BY COMPRESSION OF WEDGE SHAPED RUBBER HEEL
-ALL PLACED ON WOODEN INSERT FOR HEEL AND WOODEN SIDE KEEL

JAIPUR FOOT (INDIA'S PRIDE)

-MADE OF
RUBBER(WATERPROOF)
ALUMINIUM(FOR LEG
PIECE)
-CHEAP ,STRONG,RUST
FREE
-ALLOWS SITTING ,
SQUATING,DOES NOT
REQUIRE A SHOE



PROSTHESIS FOR UPPER LIMB AMPUTATIONS

FOREQUARTER AMPUTATIONS-

-PROSTHESIS MERELY SERVES A COSMETIC PURPOSE

-SLEEVE FITTER PROSTHESIS WITH A PLASTOZOATE CAP PADDED INSIDE WITH FOAM AND RETAINING STRAPS IS USED

Myoelectric Prosthetics

SHOULDER DISARTICULATION

- SHOULDER PIECE EXTENDED CAP TO HOLD PROSTHESIS
- ELBOW PIECE CAN BE FLEXED B PULLING ON THE FLEXION CORD WITH THE PROTRACTORS

  OF TH SHOULDER

-HANDPIECE EITHER COSMETIC OR SPLINT HOOK TYPE.

ABOVE ELBOW AMPUTATION

SAME AS PROSTHESIS FOR SHOULDER DISARTICULATION EXEPT ELBOW FLEXION IS STRONGER DUE TO ACTION OF ARM MUSCLES ALONG THE PROTRACTORS

BELOW ELBOW AMPUTATION

-THERE IS A COP SOCKET ATTACHED TO TERMINAL DEVICE

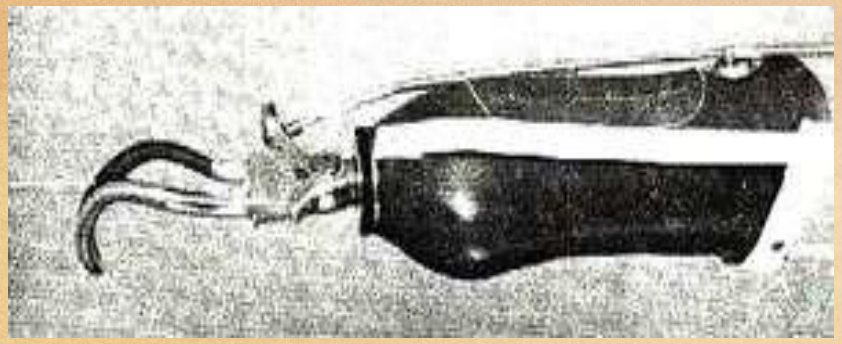
-TERMINAL DEVICE CAN BE ACTIVATED THROUGH A LOOP HARNESS

FOR WRIST DISARTICULATION

-SPLIT SOCKET FOREARM AND A WRIST

ROTATION DEVICE IS PROVIDED

-A DEVICE CAN BE PROVIDED TO LOCK FOR SUPINATION AND PRONATION




THANKS