AMPUTATIONS & PROSTHETICS
Amputation is defined as the surgical removal of a part or whole of a limb.

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Types of Amputation

► primary,
► secondary,
► late
► repeated (reamputations).

*Primary amputation* is carried out in the order of primary surgical debridement for the elimination of the nonviable part of extremity.

*Secondary amputation* is carried out when the conservative measures and surgical treatment are ineffective.
Types of Amputation

*Late amputations* are those in connection with the nonhealing wounds, fistulas, at the long course of osteomyelitis, threatening the amyloid degeneration of parenchymal organs or functionally useless extremity.
Repeated amputations or reamputations are applied after the unsatisfactory results of previous truncations of extremities or at the defect stumps preventing prosthetics, at the extension of the tissues necrosis after amputation by the reason of gangrene as a result of obliteration of the vessels or anaerobic infection progress.
Indications for Amputation

The indications for amputation are most easily remembered as the three Ds: 
**dead, dangerous** and **damned nuisance**.
Indications for Amputation

**Dead (or dying)**

Peripheral vascular disease accounts for almost 90 per cent of all amputations. Other causes of tissue death are severe trauma, burns and frostbite.
Indications for Amputation

'Dangerous' disorders are malignant tumours, potentially lethal sepsis and crush injury. In crush injury, releasing the compression may result in renal failure (the crush syndrome).
Indications for Amputation

There had been severe neglected club foot during the whole life in this elderly woman.

Amputation of an unstable lower limb segment may allow more efficient load transfer and more stable walking.

_Damned nuisance_

Retaining the limb may be worse than having no limb at all - because of pain, gross malformation, recurrent sepsis or severe loss of function.
Selection of Levels of Amputation

The classical sites of amputation of limbs were determined on the basis of the following considerations:

1. The disease process for which the amputation was done to eradicate the pathology.
2. The vascular supply to the skin flaps.
3. The requirements of limb fitting procedures and techniques available at that time.
Levels of Amputation

The levels of amputation in the upper limbs are as follows:

1. Forequarter amputation.
2. Shoulder disarticulation.
3. Above elbow amputation.
4. Elbow disarticulation.
5. Below elbow amputation.
6. Wrist disarticulation.
7. Finger amputation.
Levels of Amputation

The levels of amputation in the lower limbs are as given below:

1. Hind quarter amputation.
2. Hip disarticulation.
3. Above knee amputation.
4. Through knee disarticulation.
5. Below knee amputation.
7. Forefoot amputation.
8. Toe amputation.
Guillotine amputation is used in emergency situations for contaminated wounds or infection.

1. Divide the skin, muscle and bone at or near the same level.
2. Tie all bleeding vessels and cut the nerves sharply while under gentle tension, allowing them to retract into the wound.
3. Debride and lavage the wound every 2–5 days until it is free of dead tissue and infection. At that point, perform a definitive amputation and closure.
Forearm Amputation

Periosteum removed 1/2–3/8 in above level of resection. Bone ends beveled. Musculotendinous tissues tapered. Skin and fascial flaps formed.
Disarticulation of Wrist

Line of incision

Styloid processes removed (broken lines) to facilitate fitting of prosthesis
Transtibial Amputation

Short anterior and long posterior skin flaps created. Tibia and fibula resected.

Posterior muscle flap sutured to anterior fascia and periosteum
Transtibial Amputation

Completed closure

Skin closure

Myofascial closure

Drain
Knee Disarticulation Amputation

Line of incision

Patellar ligament being sutured to the cruciate ligaments

Cruciate ligaments

Medial condyle of femur

Myocutaneous flap

Gastrocnemius bellies

Completed closure
Transfemoral Amputation

Skin and myofascial flaps tailored for closure

Myofascial and skin flaps closed
Amputations of the Foot

Transmetatarsal amputation

Fascial and skin flaps formed. Bones transected and beveled

Completed closure (blue line indicates fascial closure)
Amputations of the Foot

Amputation of toe

Line of incision. Entire nail and part of distal phalanx excised

Amputation of 5th ray

5th ray removed. Wound closed with plantar flap
Stamp and its Management

The Stump is the residual part of the limb left after the amputation. The care of the stump is very important to provide good function in the limb.
A good stump should neither be too long nor too short. It should have good muscle power with full movement in the proximal joint and a healthy non-adherent scar. It should have a fleshy end with no bony spurs.

In lower limb amputations, the functions to be restored are weight bearing and locomotion and sensory feedback.
Stamp and its Management

The care of the stump consists of:

a) Stump bandaging with crepe bandage to improve its shape for limb fitting.
b) Stump exercises to improve its motor power and movements in the proximal joint.
c) Stump hygiene to maintain the skin and scar in good condition.
Complications of Amputation

Hematomas
Infections
Necrosis
Neuromas
Phantom sensations
Deep venous thrombosis
Terminal overgrowth
Bony spurs
Contractures
Complications of Amputation

Flexion contracture of knee in below-knee amputation prevents full extension of limb

Necrosis of wound edges caused by patient's poor circulation or excessively tight sutures
Phantom pain describes a painful sensation that can occur in a limb that is no longer present due to trauma or surgical amputation. It is often described as a shooting or burning type pain.
Phantom pain

The exact cause of phantom pain is unknown, but it's associated with the following:
- Pain experienced prior to amputation
- Nerve damage
- Prior arterial blood clot
- Neuroma (nerve tumor)

Treating Phantom Pain:
Treatment of phantom pain includes medications and other options. Medications used include opioids, anticonvulsants, antidepressants, and anesthetics, to name a few. Non-pharmacological management measures include TENS-devices, acupuncture, and electroconvulsive therapy.
Amputation in Children

The special feature of amputations in children is the growth potential of the bone in the stump.

The quickly growing bone may stretch the skin and even protrude. This will need a revision amputation to excise the excess bone.

*Terminal over growth*
Amputation in Children

Radiograph of transtibial amputation of a child shows typical “pencil point” overgrowth of tibia and fibula that leads to tenting of the skin and inability to use the prosthesis.
Amputation in Children
Types of the prostheses

- Cosmetic prostheses
- Functional
  - Body-powered prostheses
  - Myoelectric prostheses
Body-powered prosthesis

Unilateral above-elbow deficit. Standard above-elbow prosthesis operated with shoulder movements.

Cable to elbow lock

Cable to terminal device
Below-elbow myoelectric prosthesis, Transhumeral Amputee

Below-elbow prosthesis with grasping hook, which is interchangeable with other terminal devices (hammer, saw, pliers)
Characteristics of a Successful Prosthesis

- comfortable to wear,
- easy to use,
- light weight and durable, and cosmetically pleasing
- good mechanical function,
- reasonable maintenance,
- compliance with the motivation of the individual.
What should be considered when choosing a prosthesis?

- amputation level
- expected function of the prosthesis
- cognitive function of the patient
- patient's vocation
- patient's hobbies
- cosmetic importance of the prosthesis
- patient's financial resources
REQUIREMENTS TO FIT A PATIENT WITH A LOWER EXTREMITY PROSTHESIS

- sufficient trunk control,
- good upper body strength,
- static and dynamic balance,
- adequate posture.
Components of prosthesis

The major components of a lower extremity prosthesis are:

- the socket, a **sock or gel liner**, 
- a suspension system, 
- an articulating joint (if needed), 
- a pylon, 
- a terminal device.

The terminal device is typically a foot but may take other forms for water or sports activities.
Lower limb prosthetics

The prosthesis used after below knee amputation
Lower limb prosthetics

The prosthesis used after above knee amputation
Lower limb prosthetics

The prosthesis after the hip amputation

The prosthesis after the hip exarticulation
Foot prosthetics
Prosthesis Fitting and Testing

A temporary prosthesis can be fit in surgery, so when the patient awakes he or she can visualize a limb in place.

Prostheses are either preparatory or definitive.

Sometimes a preparatory prosthesis is not feasible because of financial considerations. In this case, a patient can only be fitted for the definitive (final) prosthesis. If a patient is being fitted for a final prosthesis without ever having a preparatory prosthesis, delay fitting for the socket until the residual limb is fully mature (usually 3-4 mo).
What is the difference between a prosthesis and an orthosis?

- A prosthesis is a device or an artificial substitute designed to replace, as much as possible, the function or appearance of a missing limb or body part.
- An orthosis is a device designed to supplement or augment the function of an existing limb or body part.
Orthosis

Orthosis are intended for children and adults with congenital and acquired pathology of the extremities. Orthosis make it possible to restore lost functions without a prolonged immobilization.