

AMPUTATION: PROSTHESIS



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OVERVIEW

- Definitions
- Types of prosthesis
- Materials used
- Prescription Criteria
- Recent Advancement

DEFINITIONS

Prosthetics

- The branch of medicine dealing with the Study, Production and use of artificial body parts.

Prosthesis

- It is an artificial device extension that replaces a absence/lost body part.

Prosthetist

- The professional skilled in making or fitting prosthetic devices

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TYPES OF PROSTHESIS

Types based on Function:

- Functional Prosthesis (Body-powered or Externally powered system)
- Cosmetic Prosthesis
- Activity Specific Prosthesis

Types Based on Design:

- Exoskeletal Design
- Endoskeletal Design

MATERIALS USED FOR PROSTHESIS

- 1) Wood - commonly willow which is light weight, resilient & easily shaped.
- 2) Aluminum & its alloys which is light weight, rust free & durable.
- 3) Plastic and PVC materials.
- 4) Carbon fiber light weight, strong , rust free and durable.
- 5) Leather derivatives.
- 6) costly metals Titanium, Ni, Co etc.

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TYPES OF UPPER LIMB PROSTHESIS

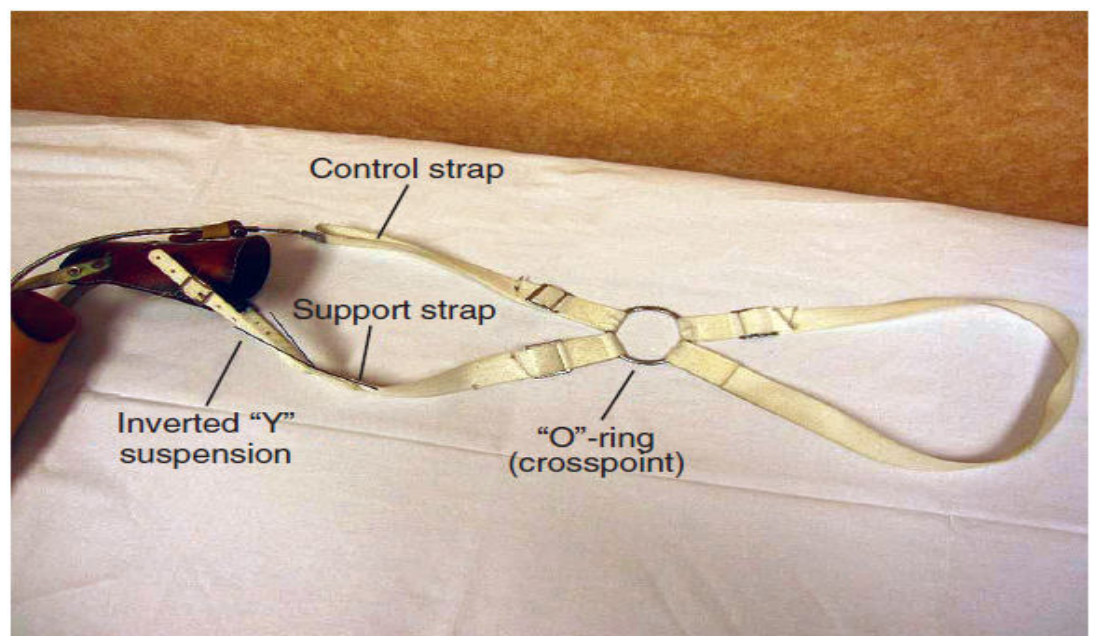
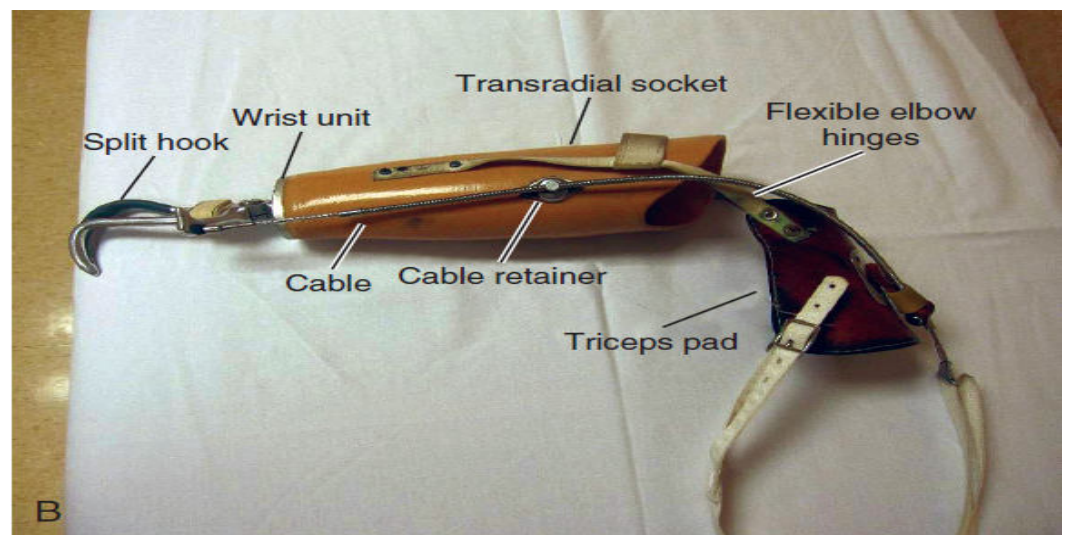
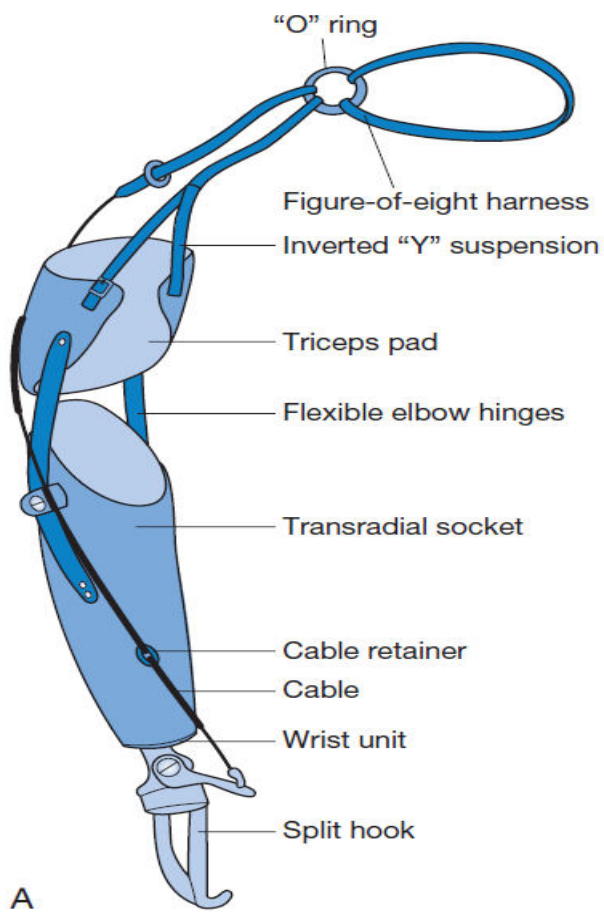
- Body-powered prostheses: use forces generated by body movements transmitted through cables to operate joints and terminal devices.
- Externally powered prostheses: use muscle contractions or manual switches to activate the prosthesis.

1) Myoelectrically controlled prosthesis - using surface electrodes to detect electrical activity from select residual limb muscles to control electric motors.

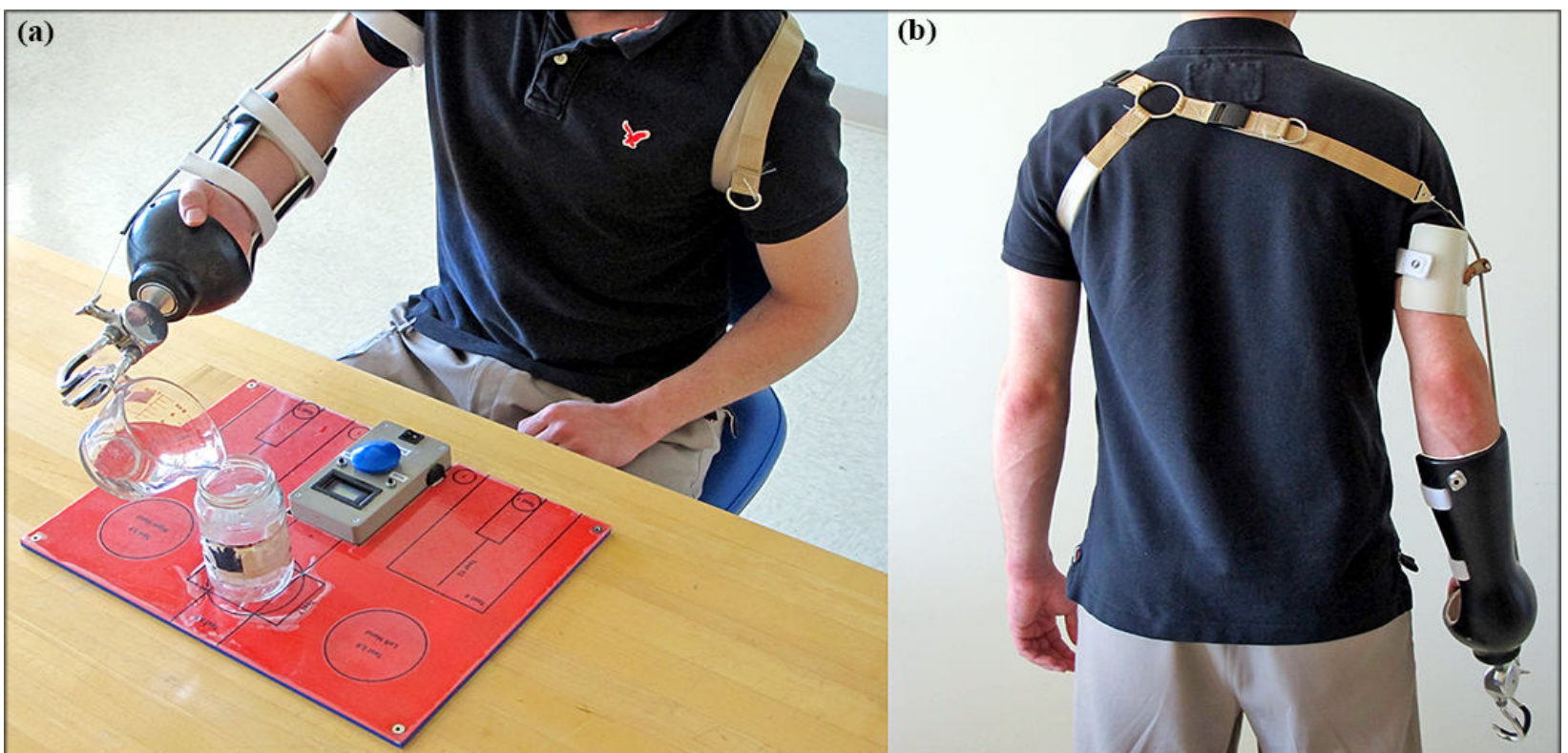
2) Switch-controlled prostheses - A switch can be activated by the movement of a remnant digit or part of a bony prominence against the switch or by a pull on a suspension

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DIFFERENT PARTS OF A UPPER LIMB PROSTHESIS

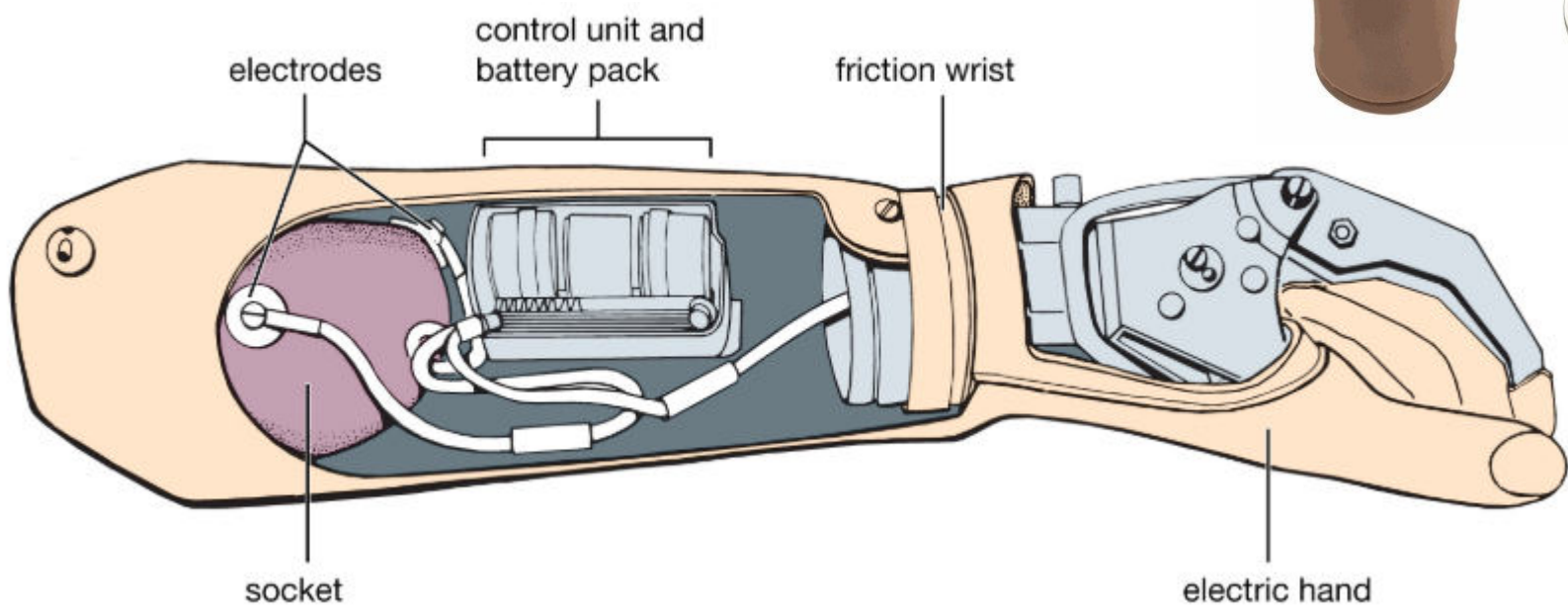


DIFFERENT PARTS OF A UPPER LIMB PROSTHESIS



MYOELECTRICALLY CONTROLLED PROSTHESIS

- The two-site/two-function (dual-site) system
- One-site/two-function (single-site) system



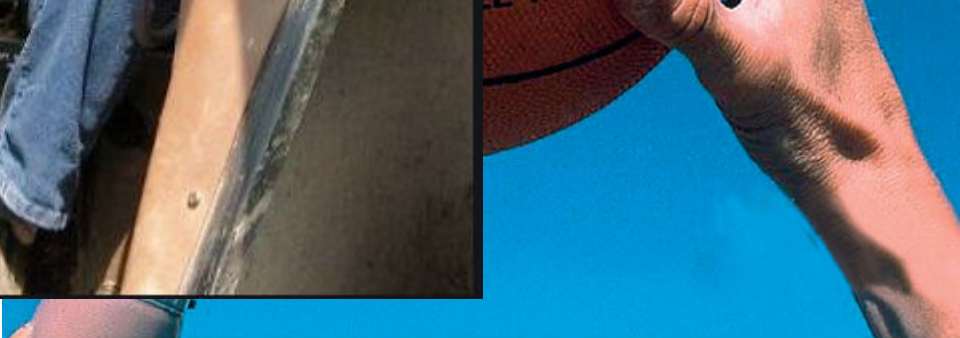
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COSMETIC PROSTHESIS



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ACTIVITY SPECIFIC PROSTHESIS



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ADVANTAGES AND DISADVANTAGES OF MYOELECTRIC AND BODY-POWERED DEVICES

| Advantages | Disadvantages |
|--|--|
| Myoelectric Devices | |
| <ul style="list-style-type: none">• Do not require a harness or cable• Looks like natural-appearing arm• Battery powered, so motor strength and coordinated mobility not as important• Newer batteries have reduced weight• Provides strong grip force | <ul style="list-style-type: none">• Higher initial cost• Heavier• Dependence on battery capacity and voltage• Higher repair cost• Dependence on battery life |
| Body-Powered Devices | |
| <ul style="list-style-type: none">• Lower initial cost• Lighter• Easier to repair• Offer better tension feedback to the body | <ul style="list-style-type: none">• Mechanical appearance• Some people have difficulty using them• Dependent on motor strength |

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BIONIC HAND

- Multi-articulating myoelectric hands
- Individual motors in each finger
- Microprocessors continuously monitor the position of each finger
- Automatically senses when a gripped item
- Different grip patterns

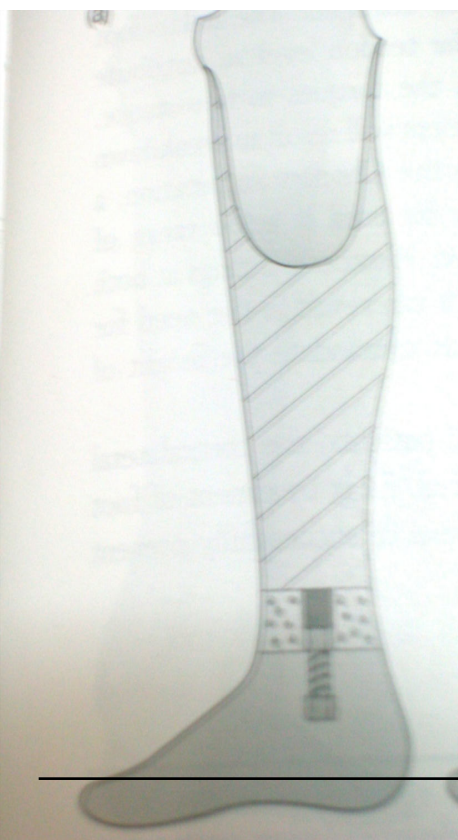


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TYPES OF LOWER LIMB PROSTHESIS

1) Exoskeletal Design

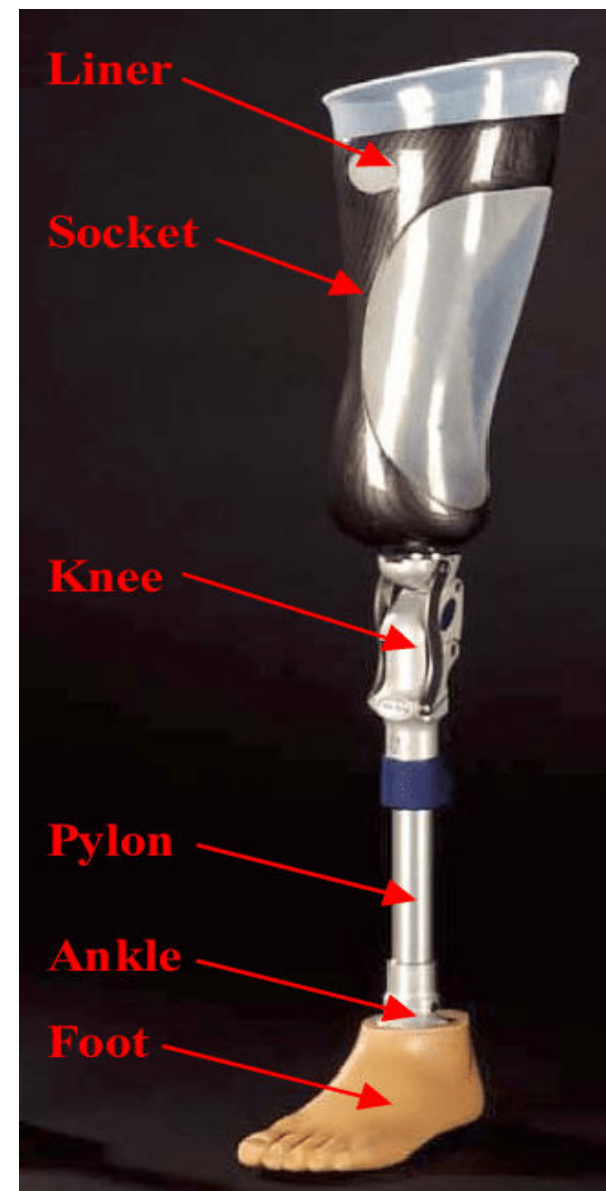
2) Endoskeletal Design



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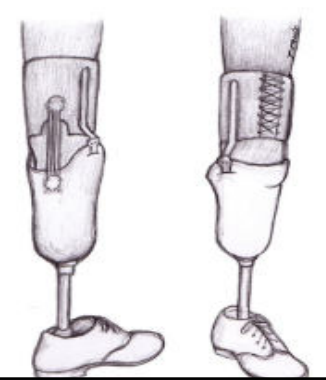
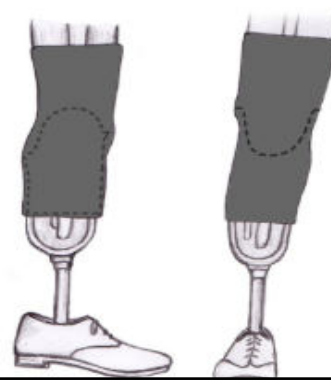
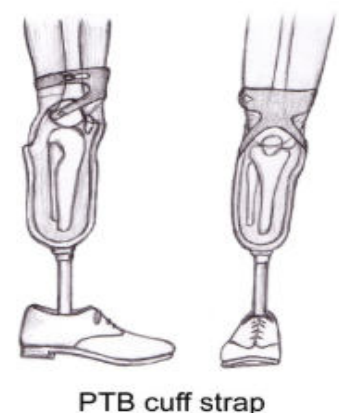
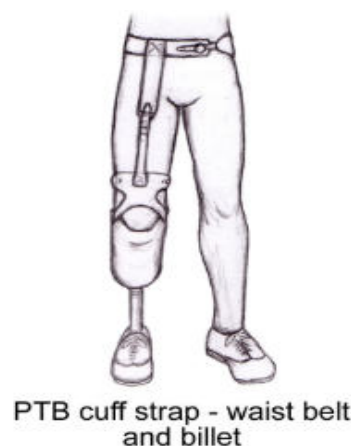
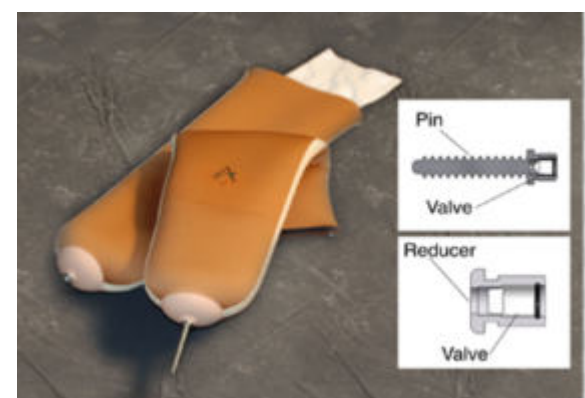
DIFFERENT PARTS OF A LOWER LIMB PROSTHESIS -

- Socket – Interface between stump and prosthesis- most important.
- Suspension – which holds prosthesis.
- Prosthetic shank – mounting block & ankle block in exoskeletal & pylon in endoskeletal prosthesis.
- Prosthetic joint – knee, ankle
- Foot / ankle foot assembly.



SUSPENSION

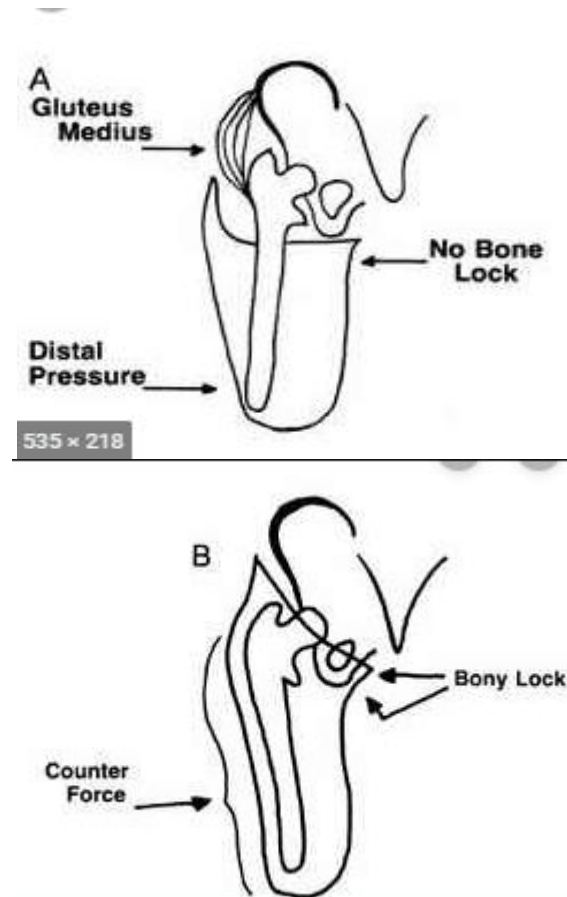
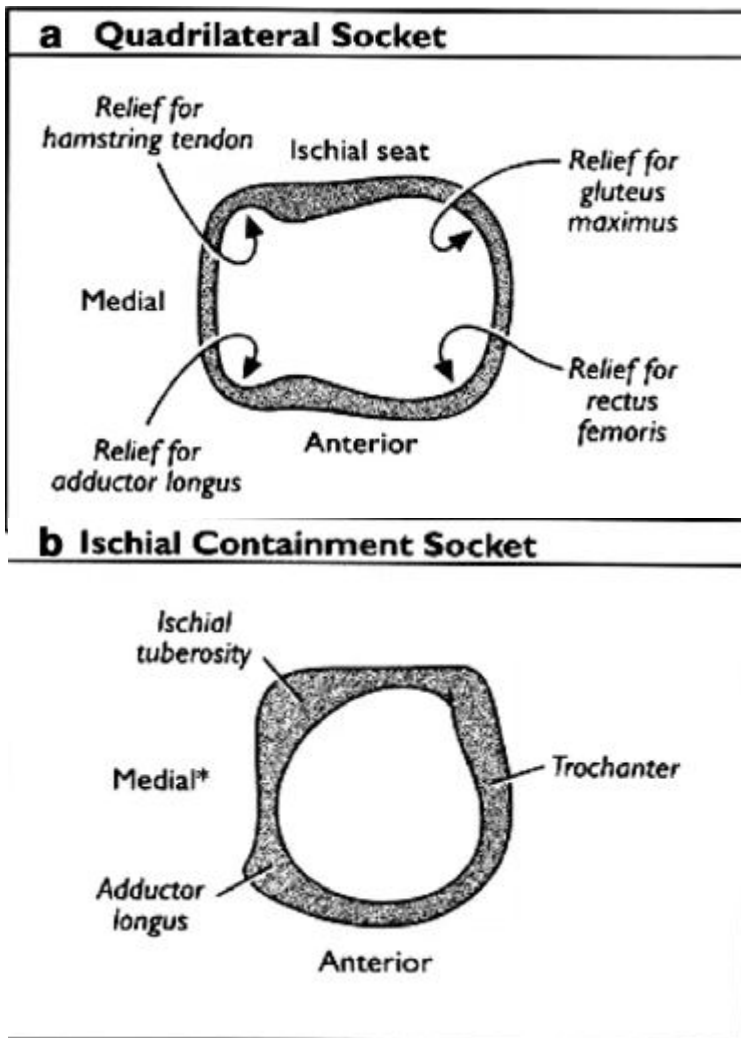
- Fork strap with waist belt
- Cuff
- Sleeve
- Supracondylar
- Supracondylar supra-patellar
- Gel or elastomeric
- Suction
- Vacuum assisted
- Pin-locking



SOCKETS

1) Quadrilateral Socket

2) Ischial containment socket



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SOCKETS

Socket design—

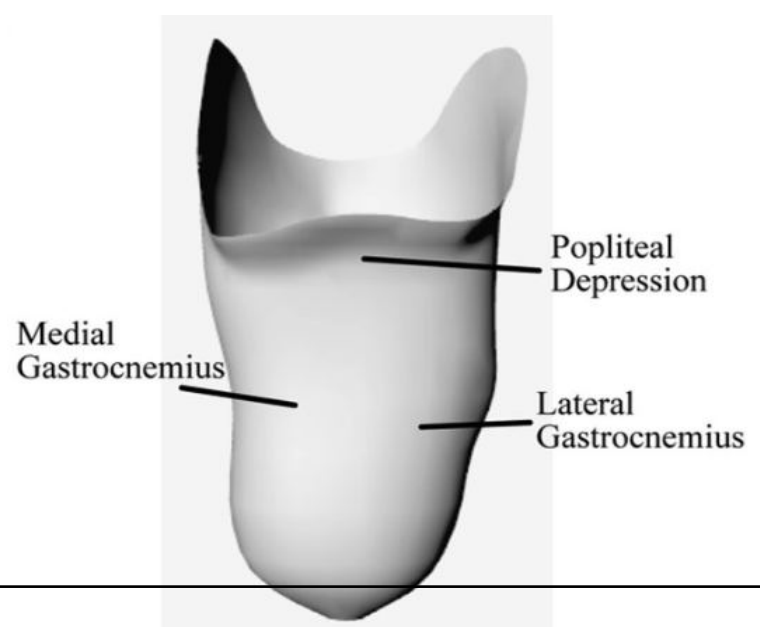
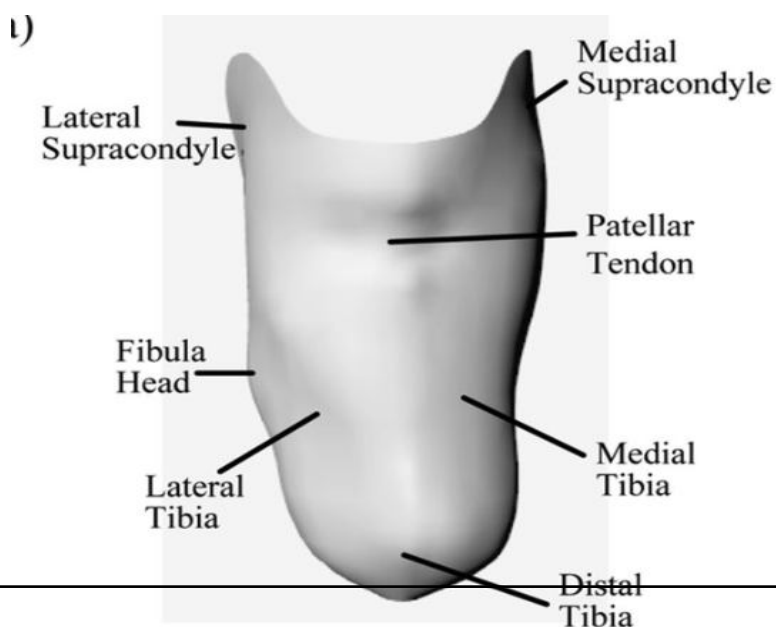
- Plug fit(obsolete)
- Patellar Tendon Bearing(PTB)
- Total Surface Bearing(TSB)



Patella Tendon Bearing Socket



Total Surface Bearing Socket



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KNEE MECHANISM

- Manual locking
- Single axis with constant friction
- Weight-activated stance control (safety knee)
- Polycentric
- Hydraulic or pneumatic swing phase control
- Hydraulic swing and stance control
- Microprocessor control (stance or stance and swing phase control)

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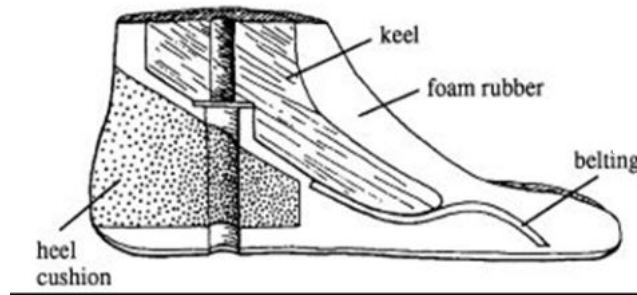
KNEE MECHANISM



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FOOT ANKLE ASSEMBLY

- 1) SACH foot
- 2) Single axis foot
- 3) Multi-axial foot
- 4) Dynamic response foot



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SYMES AMPUTATION

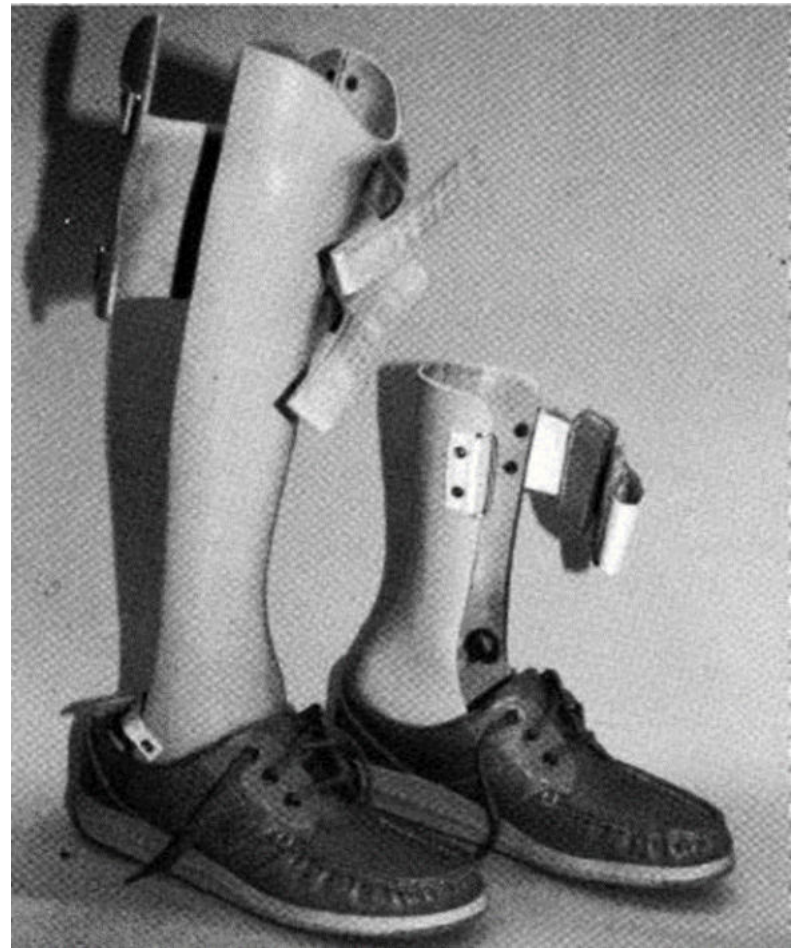
- Long residual limb & end weight bearing
- Poor cosmesis & limited foot options
- Three conventional types



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PARTIAL FOOT AMPUTATION

- AFO style prosthesis is usually needed
- It extends upto the the pateller tendon to distribute forces



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PRE PRESCRIPTION EVALUATION

- Medical factors
- Amputation type
- General health
- Stump

Stump : Scar, skin, neuroma, spur, hypersensitivity, redundant tissues, range of motion, strength and phantom pain

PRESCRIPTION CRITERIA

- Patient's requirement
- Activity Level
- Socio-Economic Condition
- Personal preference
- Availability

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PATIENT'S REQUIREMENT

Patient's Vocation

- Executive / Businessman
Better limbs (sophisticated)
- Manual worker
Heavy duty (conventional)



PATIENT'S AGE AND SEX

- Infant – Soft prosthesis
- Child – Light weight limb
- Adolescent - Functional limb advanced version limb
- Adult - Functional limb advanced version limb
- Elderly – Light weight limb
- Female – Better cosmetic limb

MEDICARE FUNCTIONAL CLASSIFICATION LEVEL (MFCL) DESCRIPTIONS

| Functional Index Level | Description | Recommended Prosthetic Components |
|------------------------|--|---|
| K0 | No ability or potential to ambulate or transfer with use of a prosthesis and prosthesis does not enhance the quality of life | None for function Potential for cosmetic prosthesis |
| K1 | Ability or potential to transfer or ambulate with a prosthesis for household distances on level surfaces at a fixed cadence | Feet: solid ankle cushion heel, single axis Knees: manual locking, weight-activated stance control |
| K2 | Ability or potential to ambulate limited community distances and traverse low-level environmental barriers. Ambulation at a fixed cadence | Feet: multiaxial and flexible keel feet Knees: weight-activated stance control |
| K3 | Ability or potential to ambulate unlimited community distances and traverse most environmental barriers. Ambulation with variable cadence | Feet: multiaxial, energy storing Knees: hydraulic, pneumatic, and microprocessor controlled |
| K4 | Ability or potential to exceed normal ambulation activities and use a prosthesis for activities exhibiting high impact, stress, or energy levels | Feet: energy storing or other specialty feet Knees: no specific limitations |

PATIENT'S EXPERIENCE

- Old amputee has good experience of previous prosthesis
- Knows the pros and cons
- Take advantage of his experience with previous prosthesis
- No need to change.

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PATIENT'S PERSONAL PREFERENCE

- May be unrealistic
- Listen
- May be possible / impossible
- Do the needful most suitable

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EXAMPLE PRESCRIPTIONS

- For a 24 year old female teacher sustained an open comminuted fracture & had a mid-thigh amputation after osteomyelitis

Adv.

- AK Prosthesis with
- Total contact thermoplastic Ischial containment socket
- TES belt suspension
- Hydraulic knee joint
- Lightweight dynamic-response foot
- Cosmetic foam cover

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EXAMPLE PRESCRIPTIONS

- For a 72 year old retired man with type II diabetes & peripheral vascular disease with BK amputation for infected non-healing ulcer & gangrene

Adv.

- BK Prosthesis with
- total contact PTB thermoplastic socket
- foam liner (soft insert)
- lightweight align able shank
- SACH foot

Thank you