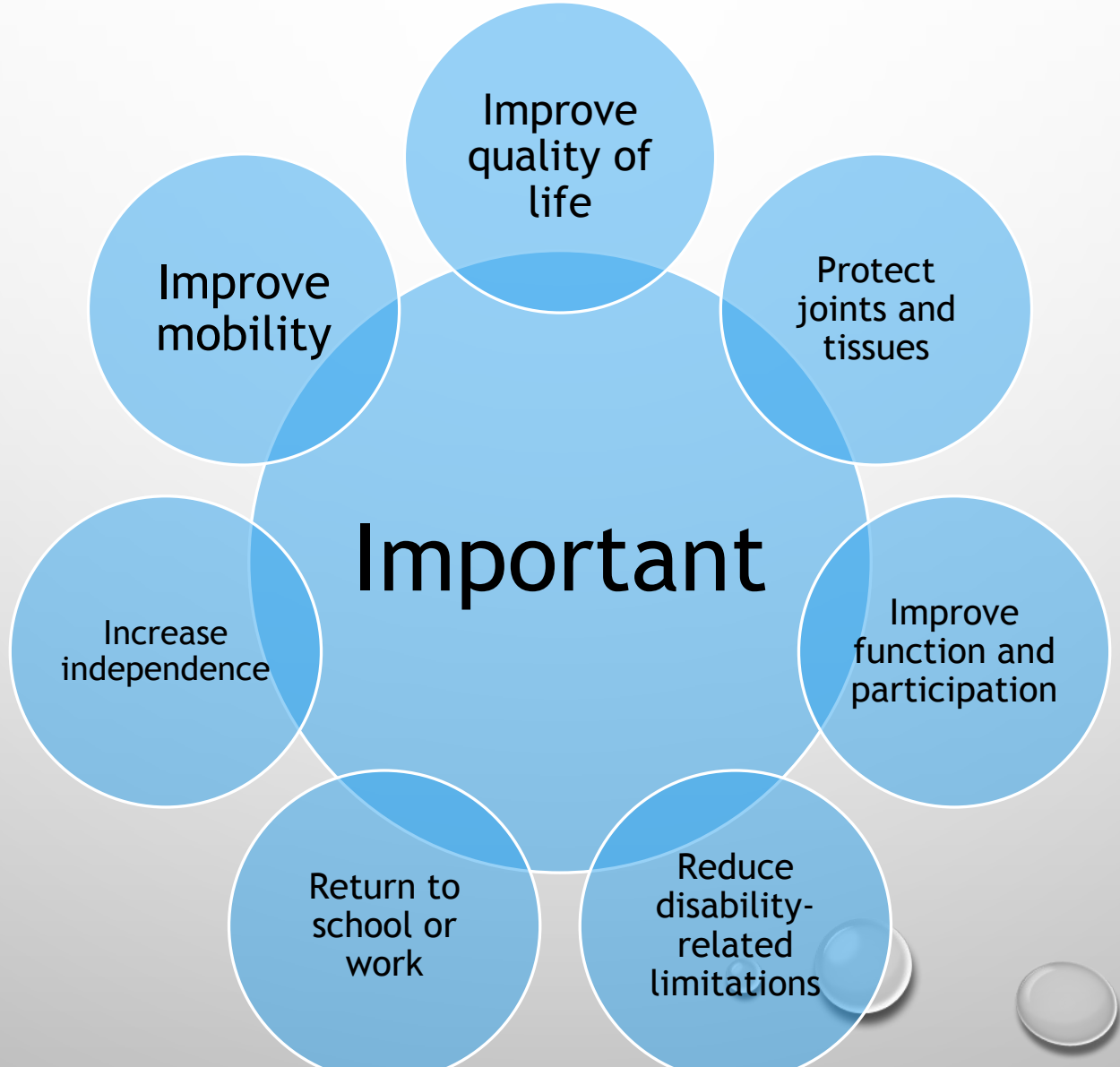
# INTRODUCTION TO PROSTHETICS AND ORTHOTICS

ENG. HUSSEIN DHAMEER HUSSEIN

# WHAT IS PROSTHETICS AND ORTHOTICS

- Prosthetics is the field concerned with the design, fabrication, fitting, and rehabilitation use of prostheses.
- Orthotics is the field concerned with the design, fabrication, fitting, and rehabilitation use of orthoses.
- orthosis as an externally applied device used to modify the structural and functional characteristics of the neuromuscular and skeletal systems, and a prosthesis as an externally applied device used to replace wholly or partly an absent or deficient limb segment.
- Simple idea: prosthesis = replaces a missing body part and orthosis = supports, aligns, protects, or assists an existing body part

# WHY IS P&O IMPORTANT



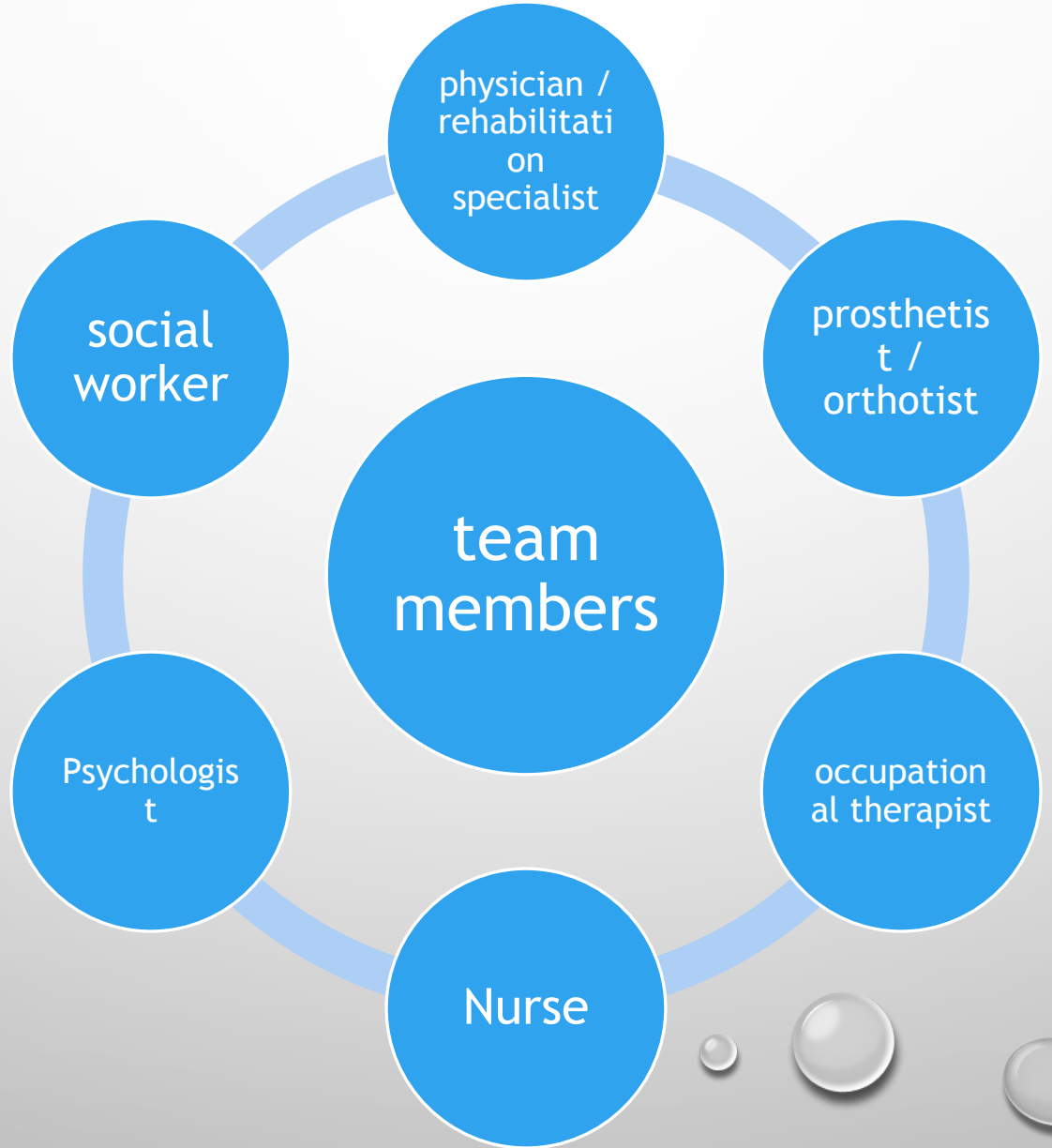
# HISTORY OF PROSTHETICS AND ORTHOTICS

- The origins of prosthetics date back to ancient civilizations, with evidence of early artificial limbs in ancient Egypt.
- Early devices were simple and made mainly from wood, leather, and metal.
- Over time, prosthetic and orthotic practice developed from basic craftsmanship into a more organized clinical field.
- Major progress occurred during the 20th century, especially after wars and epidemics, when the need for rehabilitation services increased.
- The term “orthotics” became widely adopted in the late 1940s, reflecting the development of more functional and dynamic supportive devices.
- Today, prosthetics and orthotics are recognized as an essential part of

# PROSTHETICS AND ORTHOTICS IN REHABILITATION

- P&O is a major part of rehabilitation medicine. It works together with:
  - medical treatment
  - physical rehabilitation
  - functional training
  - gait training
  - patient education
  - Long-term follow-up
- Key concept: A device alone is not enough. Successful rehabilitation requires: proper assessment, correct design, good fit, training, review and adjustment

# MULTIDISCIPLINARY REHABILITATION TEAM



# PROFESSIONAL ROLES IN P&O

- Prosthetist/orthotist:
  - performs assessment
  - contributes to device design
  - selects components/materials
  - fits and aligns the device
  - evaluates function
  - follows up with the patient
- P&O is both:
  - a clinical field
  - and a technical/engineering-based field

# ROLE OF PROSTHETISTS AND ORTHOTISTS WITHIN THE REHABILITATION TEAM

- Prosthetists and orthotists are important members of the multidisciplinary rehabilitation team.
- They assess the patient’s condition and functional needs.
- They participate in treatment planning and help choose the most appropriate prosthetic or orthotic intervention.
- They are responsible for the design, fabrication, fitting, and adjustment of devices.
- They monitor outcomes and modify the device according to the patient’s progress.
- They work in coordination with physicians, physiotherapists, occupational therapists, nurses, and technicians to improve mobility, function, and independence.
- Their role combines both clinical decision-making and technical skills.

# DIFFERENCE BETWEEN PROSTHESIS AND ORTHOSIS

- Prosthesis used when a body part is missing.
- Examples:
  - transtibial prosthesis
  - transfemoral prosthesis
  - upper-limb prosthesis
- Orthosis used when the limb or body part is present but needs support or control.
- Examples:
  - foot orthosis
  - AFO
  - Wrist orthosis

# BASIC CLASSIFICATION

- Orthoses may be classified by:
  - Body region
  - Joint control
  - Function
  - Rigidity
- Prostheses may be classified by:
  - Level of amputation
  - Body region
  - Type of components
  - Suspension method
  - Functional purpose

## REGIONAL ORTHOSIS

| Cervical orthosis (CO) | Head cervical orthosis (HCO) | Head cervical thoracic orthosis (HCTO) | Sacral orthosis (SO) | Lumbo-sacral orthosis (LSO) | Thoraco Lumbo-sacral orthosis (TLSO) |
|---|---|---|---|---|---|

**Upper extremity orthosis**

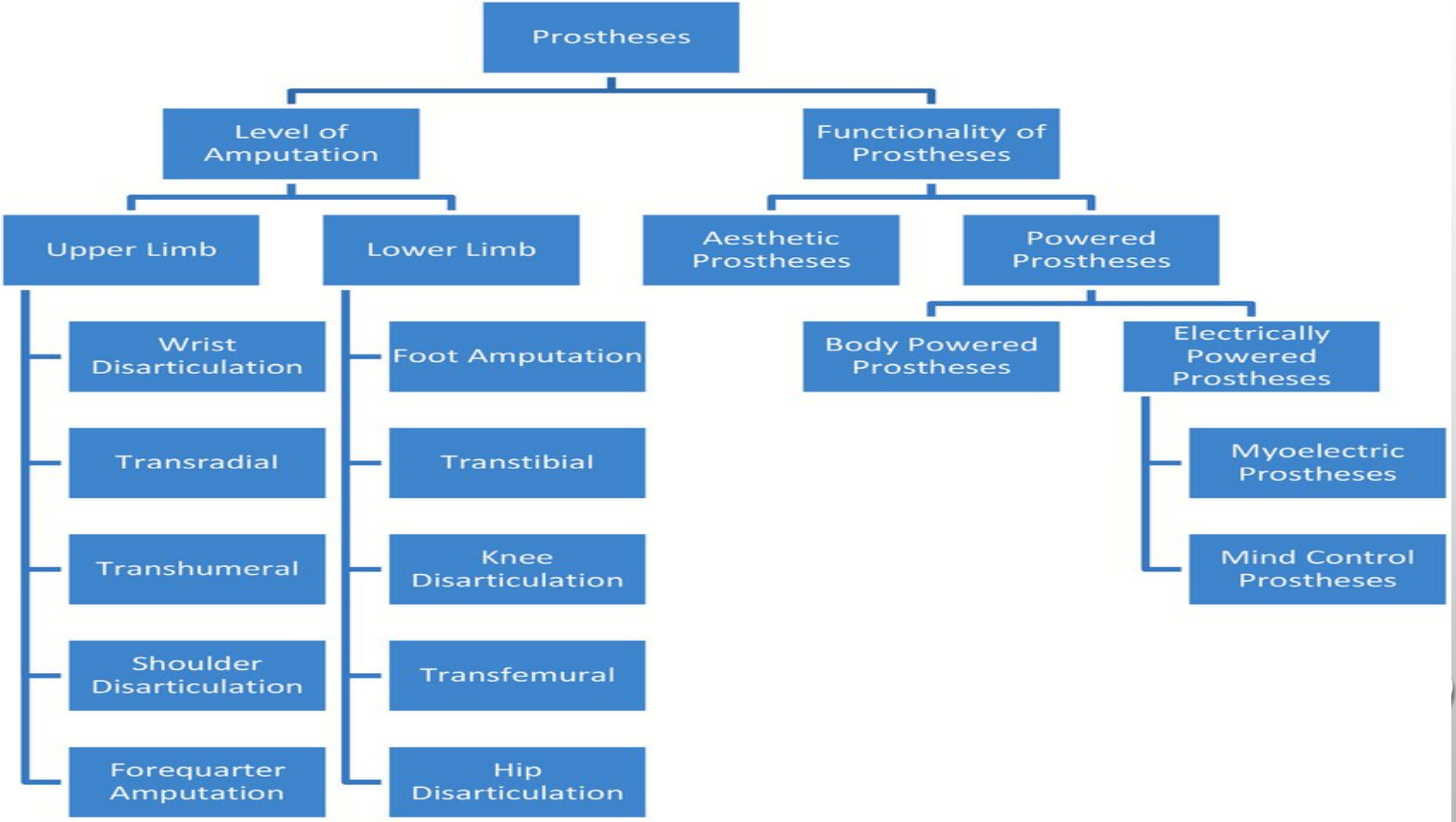
- *Shoulder and arm orthosis*
- *Elbow orthosis*
- *Wrist orthosis*
- *Hand orthosis*

**Lower extremity orthosis (CALIPERS)**

- *Foot orthosis (FO)*
- *Ankle – foot orthosis (AFO)*
- *Knee-ankle foot orthosis (KAFO)*
- *Hip-knee-ankle-foot orthosis (HKAFO)*

## FUNCTIONAL ORTHOSIS

| | |
|---|---|
| Supportive | • Calipers, gaiters |
| Functional | • Orthotics for foot drop splint |
| Corrective | • Club foot boot in congenital talipes equino varus |
| Protective | • Rigid four post collar for fractured cervical vertebrae |
| Strengthening | • In case of Tenodesis splint |
| Pain relieving | • Lumbosacral corset in case of pain in lower back |
| Weight relieving | • Pain relieving orthosis |


Prostheses
Level of Amputation
Functionality of Prostheses
Upper Limb
Lower Limb
Aesthetic Prostheses
Powered Prostheses
Wrist Disarticulation
Transradial
Transhumeral
Shoulder Disarticulation
Forequarter Amputation
Foot Amputation
Transtibial
Knee Disarticulation
Transfemural
Hip Disarticulation
Body Powered Prostheses
Electrically Powered Prostheses
Myoelectric Prostheses
Mind Control Prostheses

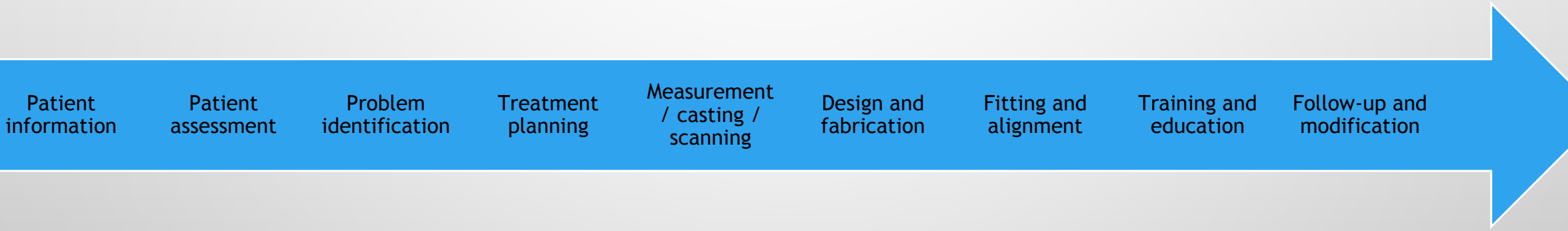
# COMMON GOALS OF AN ORTHOSIS

- Support weak muscles
- control abnormal motion
- improve alignment
- protect healing tissues
- reduce pain
- prevent or limit deformity
- improve function during standing or walking

# COMMON GOALS OF A PROSTHESIS

- Replace a missing limb segment
- restore basic function
- improve mobility and balance
- assist gait
- improve independence
- improve body image and confidence

# GENERAL P&O SERVICE PATHWAY



# COMMON TERMINOLOGY AND AMPUTATION

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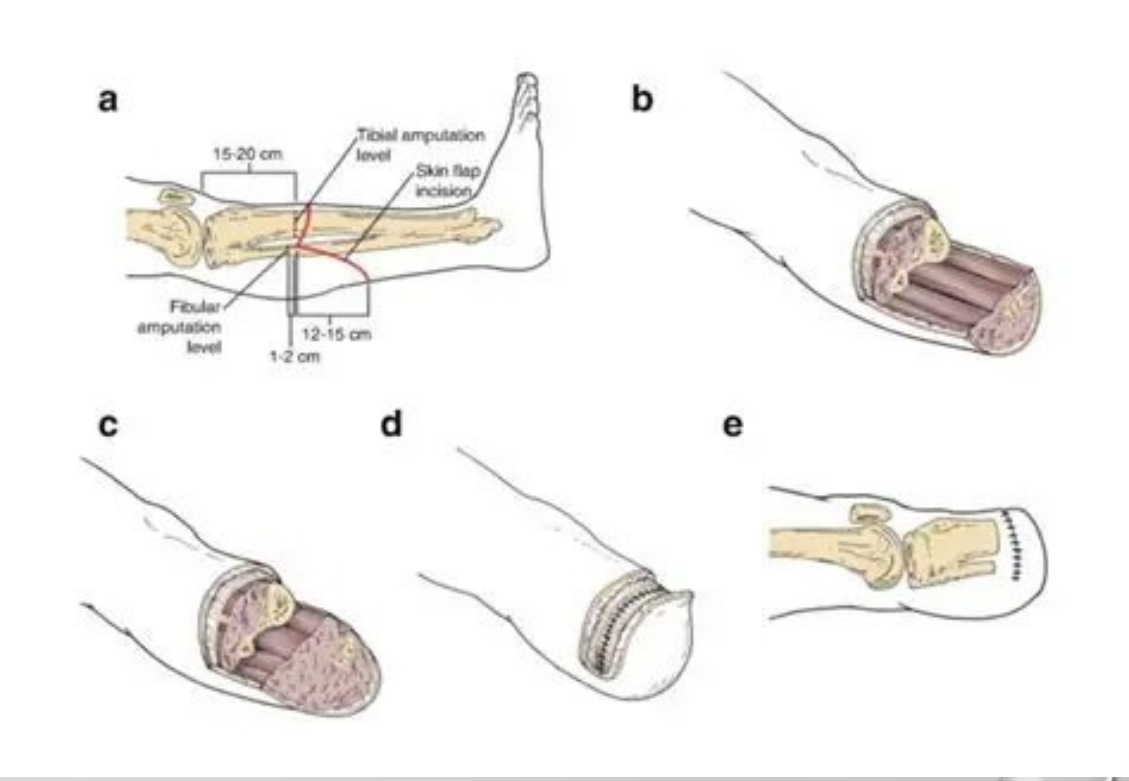
# AMPUTATION

- Amputation is the surgical removal of all or part of A limb or body segment.
  It may involve the upper limb or lower limb, and it may be performed at different anatomical levels depending on the condition of the tissues.
- Key idea:
  amputation is usually done when the limb cannot be saved safely or functionally.



# CAUSES OF AMPUTATION

- Amputation may be necessary because of:

1. Severe trauma
2. Vascular disease
3. Diabetes-related complications
4. Infection
5. Tumors or malignancy
6. Nonviable or gangrenous tissue
7. Congenital limb deficiency in some contexts

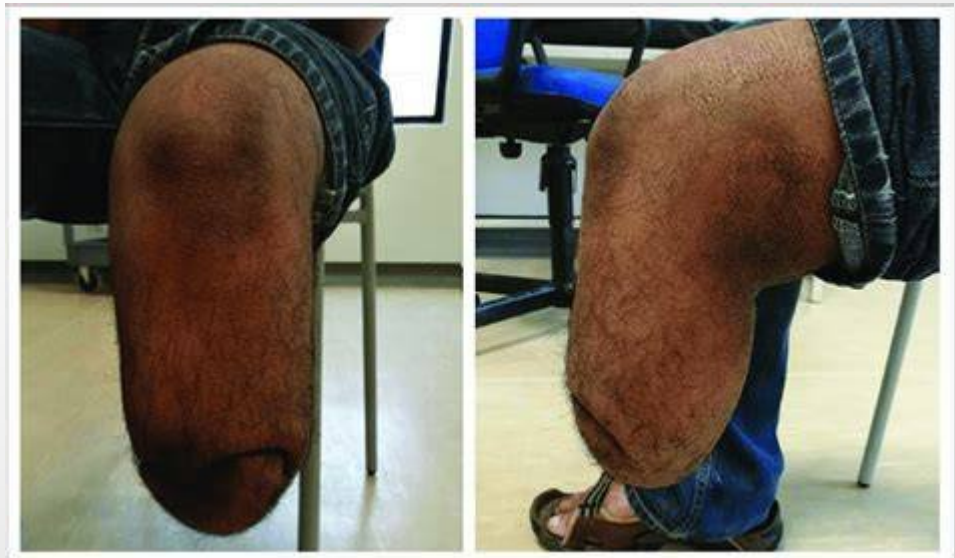
# POSTOPERATIVE AND REHABILITATION CARE

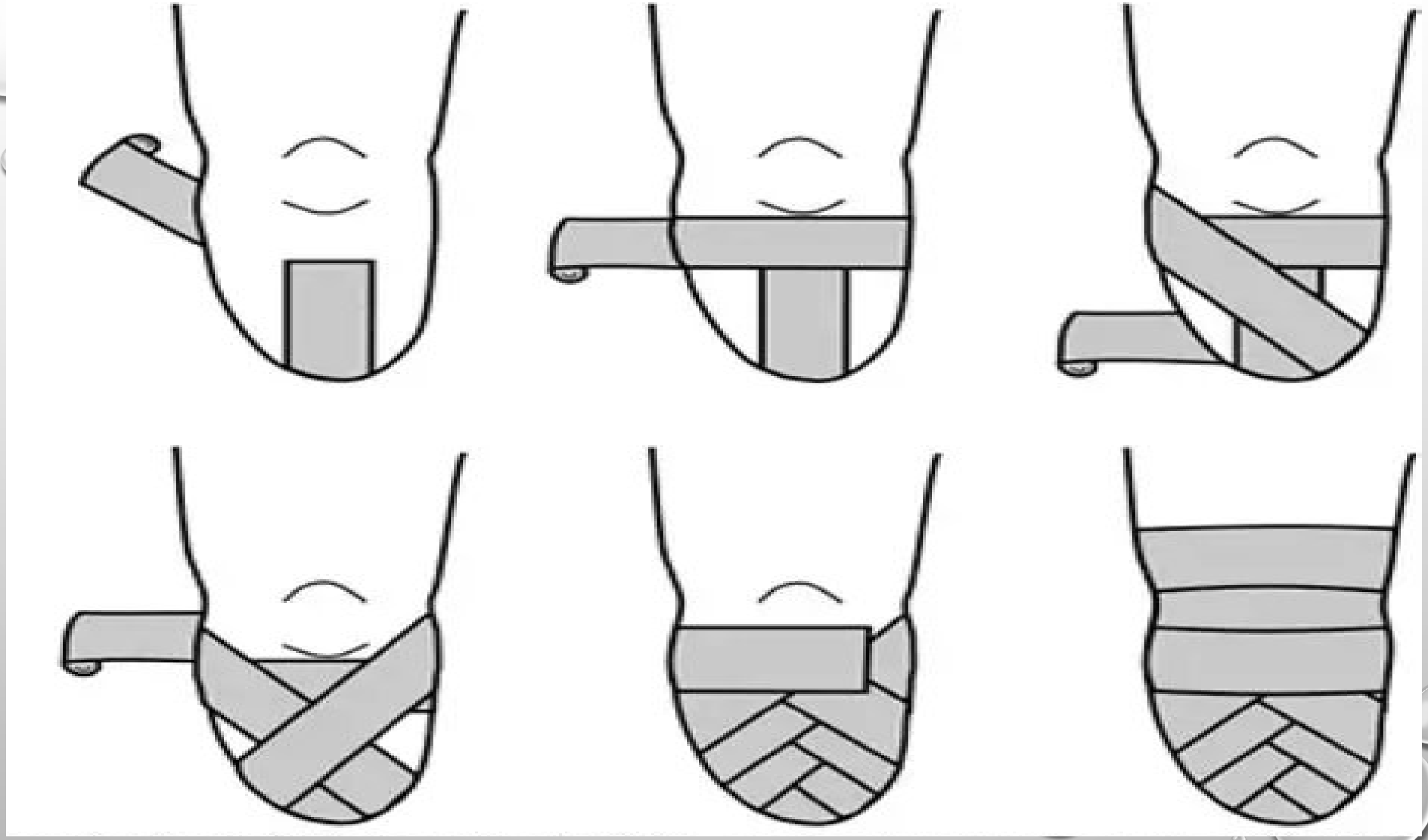
- After amputation, management includes:

1. Wound care
2. Edema control
3. Pain management
4. Maintaining joint range of motion
5. Strengthening and conditioning
6. Desensitization of the residual limb
7. Psychological support
8. Prosthetic planning and training

# BASIC DEFINITIONS

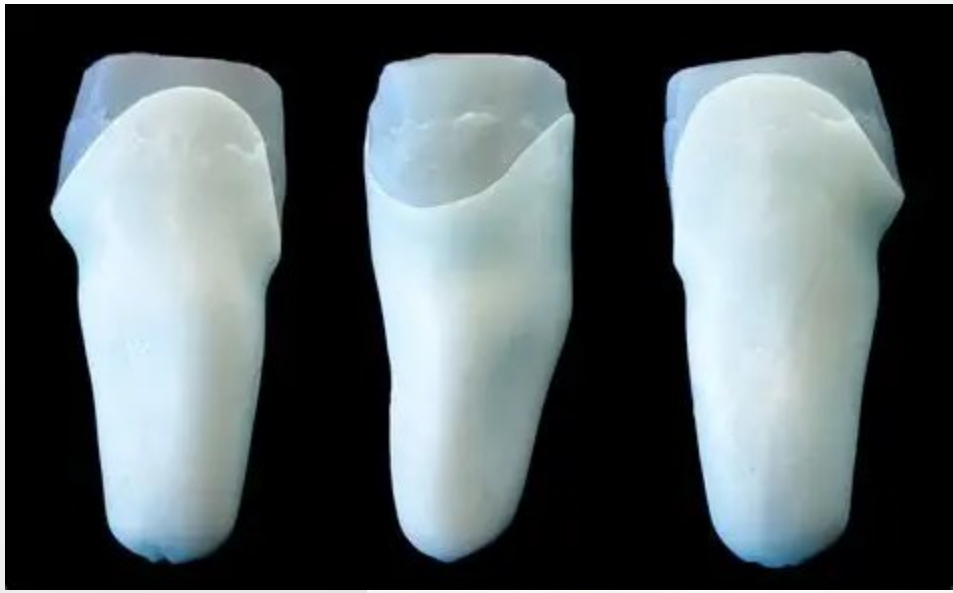
- **Residual limb:** The part of the arm or leg that remains after amputation.
- **Stump:** A common older term for the residual limb.
- **Residuum:** Another term sometimes used for the residual limb
- **Edema :** Swelling of the residual limb.
- **Shrinker:** An elastic device used to reduce swelling and help shape the residual limb before prosthetic fitting.
- **Distal:** Farther from the center of the body.
- **Proximal:** Nearer to the center of the body





# BASIC DEFINITIONS

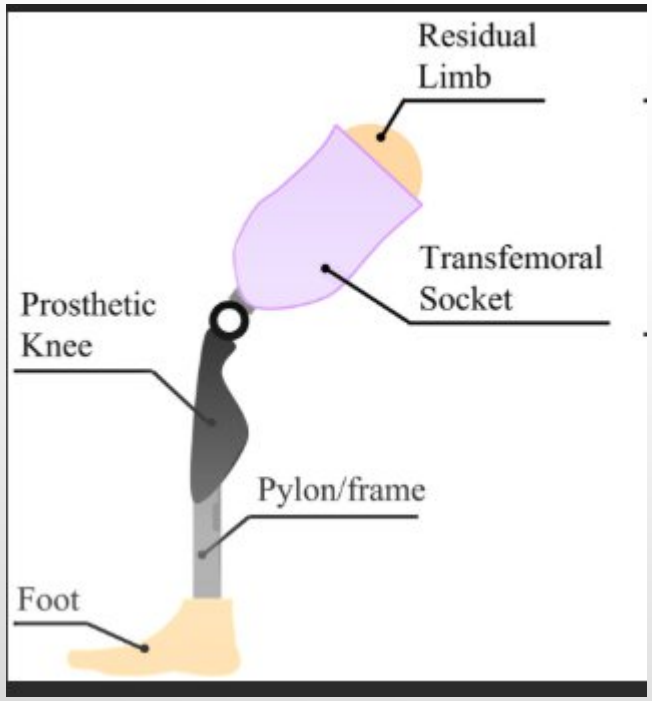
- **Socket:** The part of the prosthesis that surrounds the residual limb and connects it to the prosthetic components.
- **Liner:** A roll-on interface that helps with comfort, protection, and suspension.
- **Suspension system:** The method used to keep the prosthesis attached to the residual limb.
- **Alignment:** The position of the socket in relation to the prosthetic foot and knee.
- The socket is the main interface between the user and the prosthesis, and good socket fit is essential



# BASIC DEFINITIONS

- **Pylon:** A Rigid Support Member Between The Socket Or Knee Unit And The Prosthetic Foot.
- **Terminal Device:** In Upper-limb Prostheses, The Component That Performs The Hand Function, Such As A Hook Or Prosthetic Hand.
- **Temporary socket:** A Temporary Socket Used To Evaluate Fit Before Fabricating The Definitive Socket.
- **Pistoning:** Up-and-down Movement Of The Residual Limb Inside The Socket During Walking.
- These Terms Are Especially Important When Discussing Prosthetic Fit And Component Select


SOCKET
PYLON
FOOT


Residual Limb
Transfemoral Socket
Prosthetic Knee
Pylon/frame
Foot


Harness
Control cable
Socket
Terminal device
Wrist

# BASIC DEFINITIONS

- **Brace:** type of orthosis support and allow movement.
- **Splint:** type of orthosis prevent movement.

# CLASSIFICATION OF PROSTHESES AND ORTHOSES

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# WHY DO WE CLASSIFY PROSTHESES AND ORTHOSES

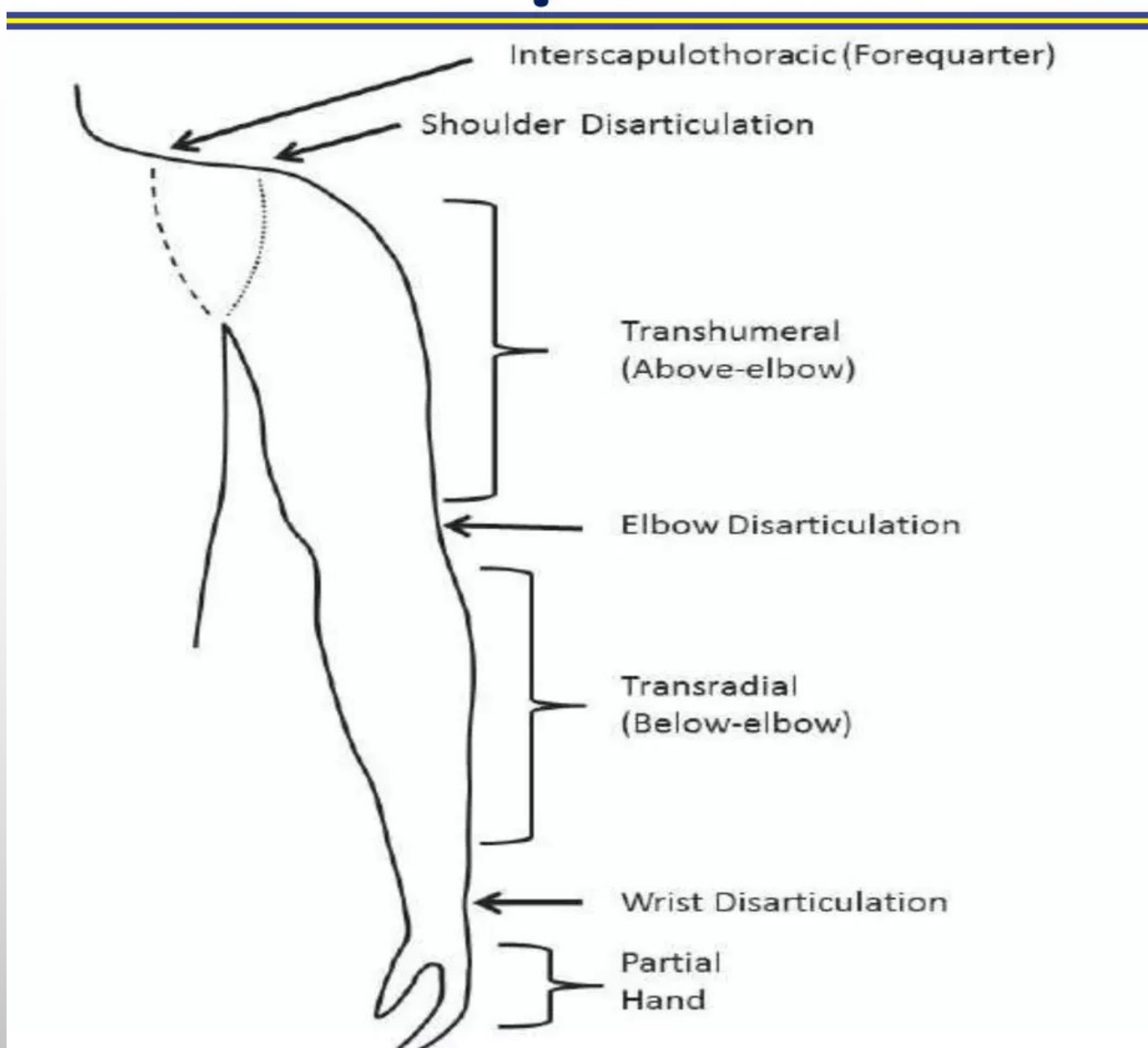
- Classification is important because it helps clinicians to:
  - Describe the device accurately
  - Communicate clearly with the rehabilitation team
  - Choose the correct treatment option
  - Document patient condition and device type
  - Compare devices in education, research, and clinical practice
- International ISO standards exist specifically to classify prosthetic components, orthoses, amputation terminology, lower-limb orthoses, soft orthoses, and foot orthosis

# BASIS OF PROSTHETIC CLASSIFICATION

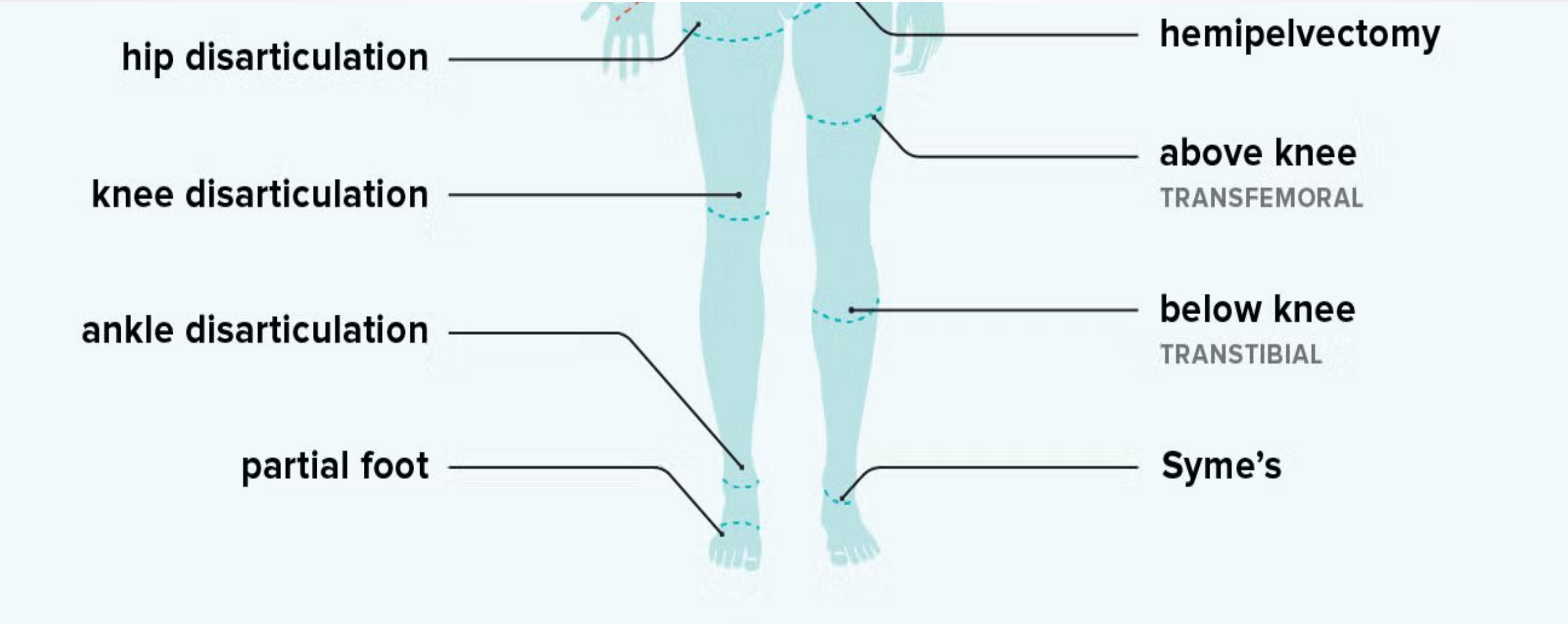
| | |
|---|---|
| Body region | • upper-limb prosthesis<br>• lower-limb prosthesis |
| Level of amputation | • transtibial<br>• Transradial<br>• Etc….. |
| Function or control system | • cosmetic / passive<br>• body-powered<br>• externally powered / myoelectric |
| Structural design | • Exoskeletal: hard outer shell, durable, less adjustable<br>• Endoskeleton: inner modular structure, lighter, easier to align and adjust |

# UPPER-LIMB AMPUTATION LEVELS

- Trauma is the most common reason for upper extremity amputations except for shoulder disarticulation and forequarter amputations, for which malignant tumors are the primary reasons.
- Small stump distal to the elbow can be functionally better than a long above-elbow amputation.
- A prosthetic limb cannot adequately replace the sensibility of the hand, and the hanction of a prosthetic



# LOWER-LIMB AMPUTATION LEVELS



# BASIS OF AMPUTATION-LEVEL CLASSIFICATION

- Amputation levels are not chosen randomly. They are classified and described according to:

- Anatomical level
- Remaining limb length
- Joint involvement
- Residual limb condition
- Functional expectations
- Tissue viability
- Adequate circulation, with the goal of preserving functional length.

# BASIS OF ORTHOTIC CLASSIFICATION

- Orthoses are commonly classified according to:

➢Body region or joints encompassed

➢Function or clinical objective

➢Structure or rigidity

➢Material or design

➢Type of motion control

# CLASSIFICATION OF ORTHOSES BY ANATOMICAL REGION

- Orthoses are usually named according to the body segments or joints they include.
- Lower-limb orthoses

➢FO = foot orthosis

➢AFO = ankle-foot orthosis

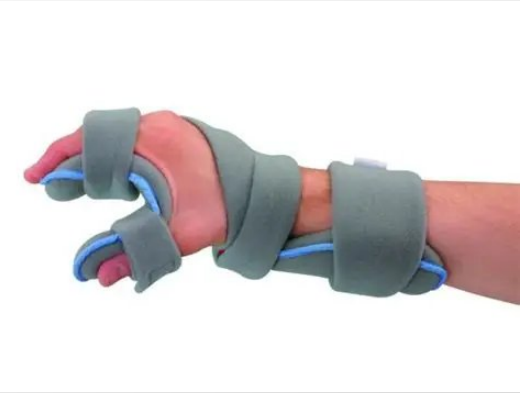
➢KO = knee orthosis

➢KAFO = knee-ankle-foot orthosis

➢HKAFO = hip-knee-ankle-foot orthosis

# CONT.

- Upper-limb orthoses
  - FO = finger orthosis
  - TO = thumb orthosis
  - HO = hand orthosis
  - WHO = wrist-hand orthosis
  - EWHO = elbow-wrist-hand orthosis
  - SEO = shoulder-elbow orthosis
  - SEWHO = shoulder-elbow-wrist-hand orthosis




# CONT.

- SPINAL ORTHOSES

➢CO = CERVICAL ORTHOSIS

➢CTO = CERVICOTHORACIC ORTHOSIS

➢TLSO = THORACO-LUMBO-SACRAL ORTHOSIS

➢LSO = LUMBOSACRAL ORTHOSIS

# BASIS OF ORTHOTIC CLASSIFICATION BY FUNCTION

- Supportive orthoses
- Protective orthoses
- Corrective orthoses
- Accommodative orthoses
- Immobilizing orthoses
- Motion-controlling orthoses
- Weight-relieving or offloading orthoses

# TYPES OF ORTHOSES BY STRUCTURE

- Rigid orthoses: Provide strong support and motion restriction
- Articulated orthoses: Allow controlled joint motion
- Soft orthoses: Provide compression, mild support, and proprioceptive assistance

# BASIC FUNCTIONAL ANATOMY AND BIOMECHANICS FOR PROSTHETICS AND ORTHOTICS

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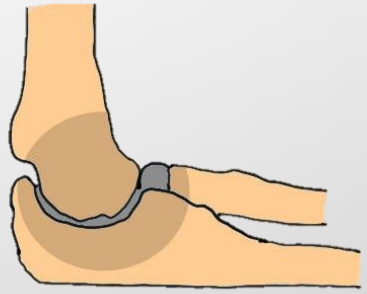
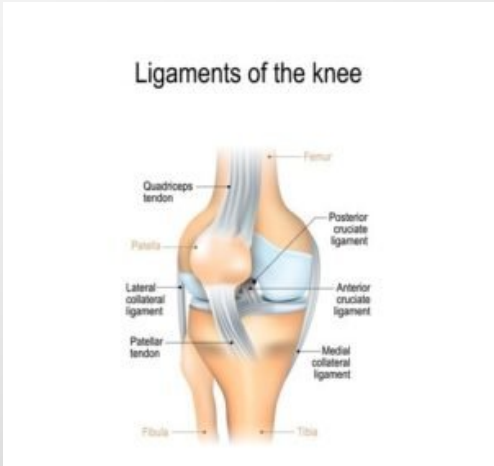
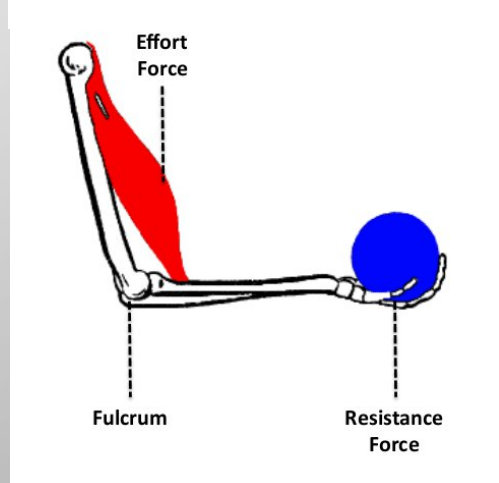
# WHAT IS FUNCTIONAL ANATOMY?

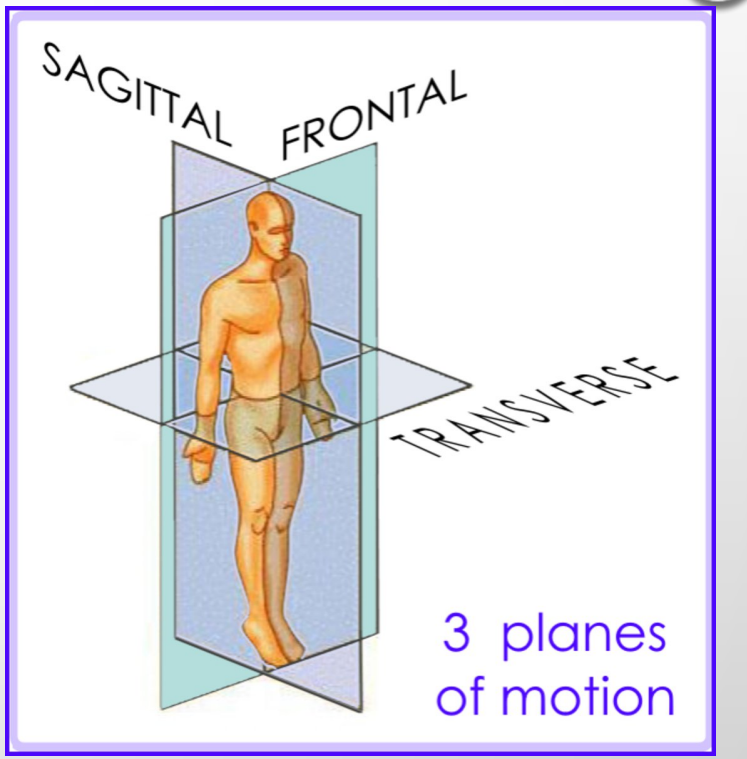
- Functional anatomy is the study of body structures in relation to movement and function.
- main elements:
  - ➢Bones provide shape and support
  - ➢Joints allow or guide movement
  - ➢Muscles generate force
  - ➢Ligaments and soft tissues provide stability
  - ➢Nerves coordinate motion and control
- in P&O
- We study anatomy not only to know structure





# PLANES, AND MOVEMENTS




- main planes
  - ➢Sagittal plane: flexion / extension
  - ➢Frontal plane: abduction / adduction
  - ➢Transverse plane: rotation
- why this matters in P&O
- prosthetic alignment problems are often described by plane
- orthotic control is also described by plane
- example: an AFO mainly affects motion in the sagittal

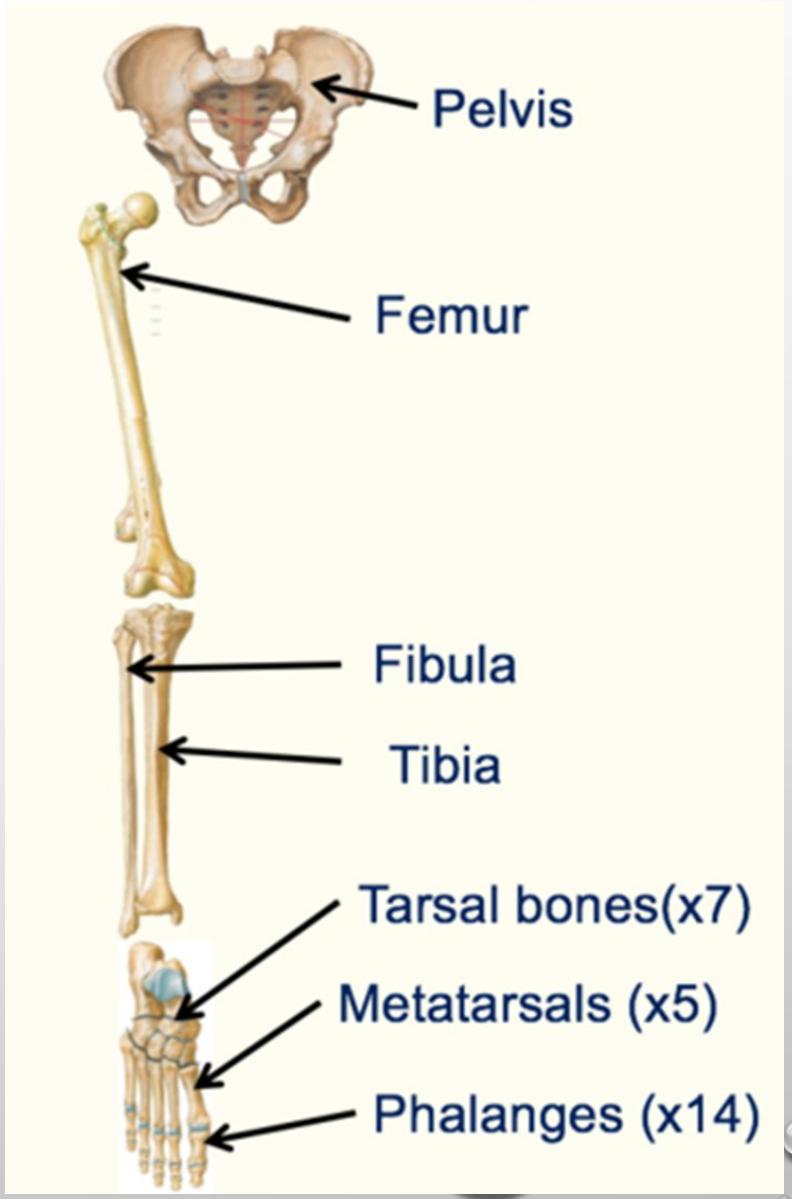
# KEY LOWER-LIMB ANATOMY FOR P&O

- IMPORTANT JOINTS

➢HIP: PROVIDES TRUNK SUPPORT AND PELVIC STABILITY

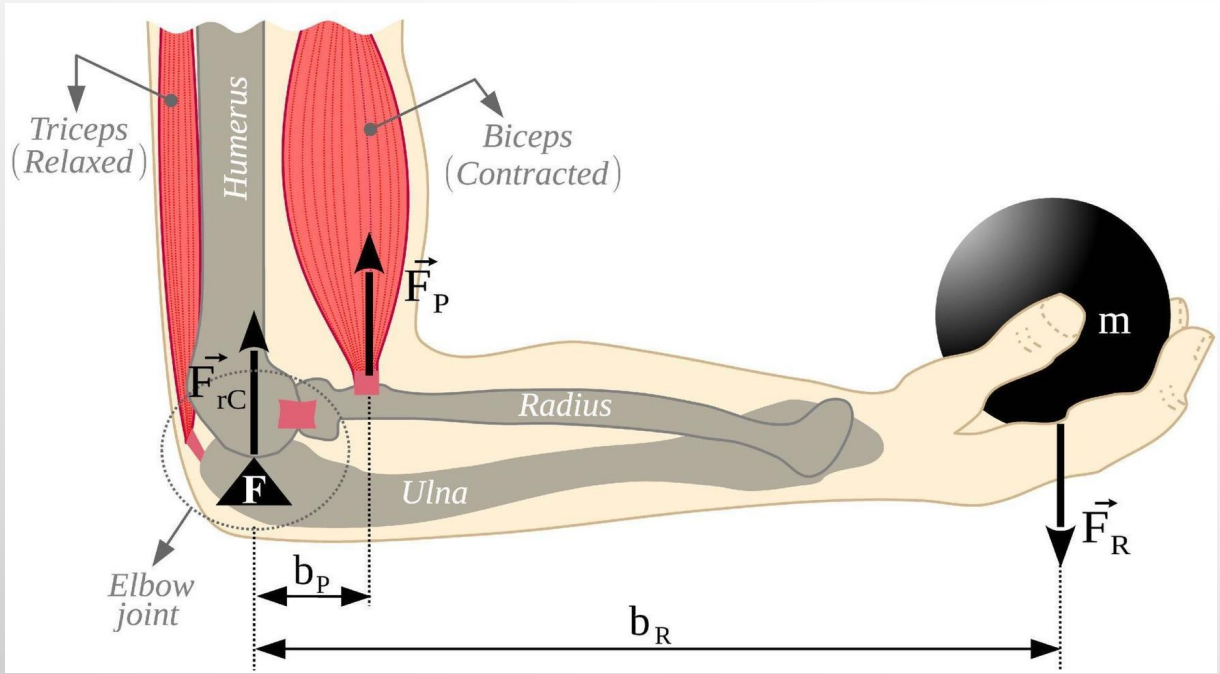
➢KNEE: CRITICAL FOR EFFICIENT WALKING AND STANCE CONTROL

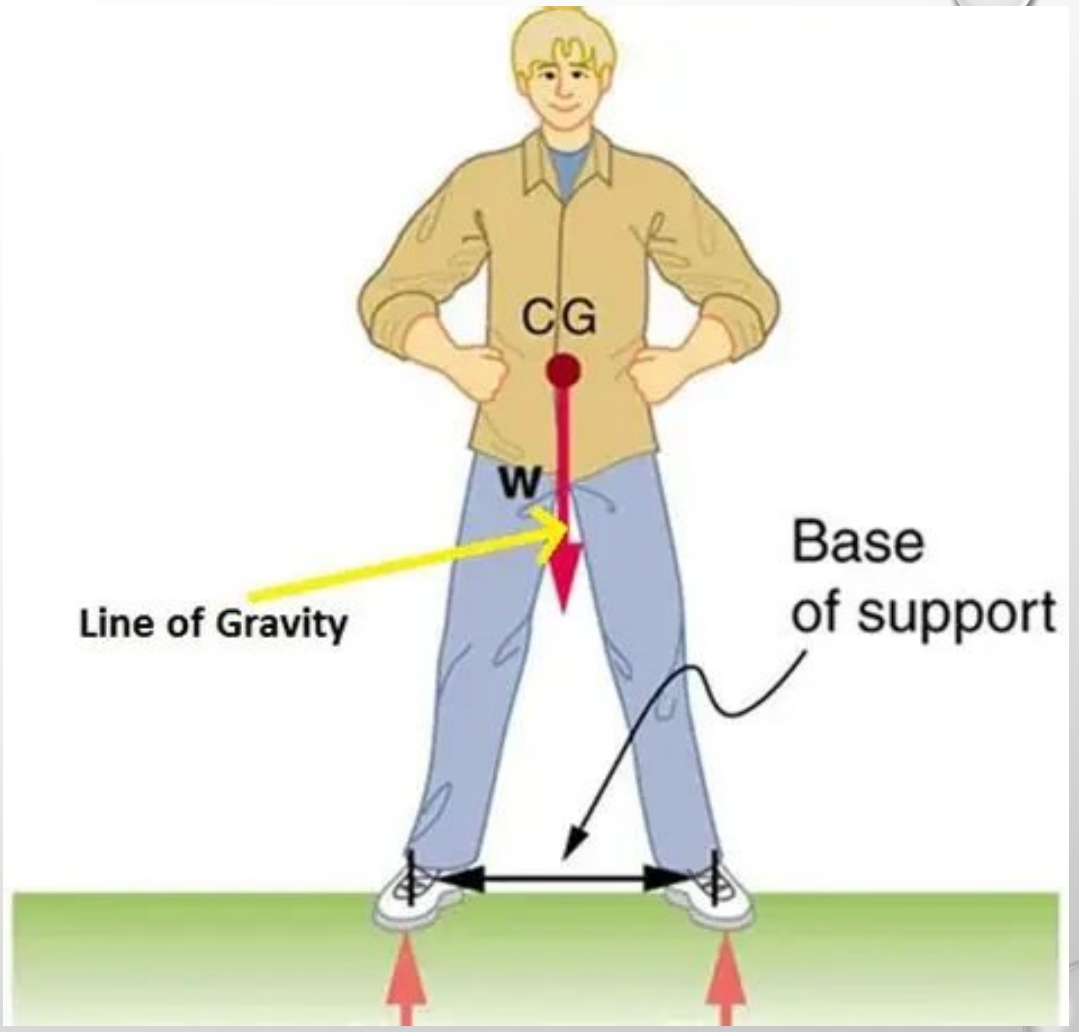
➢ANKLE-FOOT COMPLEX: SUPPORTS BODY WEIGHT, ABSORBS SHOCK, AND HELPS PUSH THE BODY



# BASIC BIOMECHANICS

- Force: a push or pull
- Moment: turning effect of a force around a joint
- Lever arm: distance between a force and the joint center
- Center of mass: the point where body mass is balanced
- Base of support: the area under the body that provides stability
- Ground reaction force (GRF): force from the ground acting on the body during standing and walking
- Clinical note
- P&O design often tries to change force, moment, or lever arm to improve function. That is the mechanical basis of both orthoses and prosthetic alignment.


Triceps
(Relaxed)
Humerus
Biceps
(Contracted)
$\vec{F}_P$
m
$\vec{F}_{rC}$
Radius
F
Ulna
$\vec{F}_R$
Elbow
joint
$b_P$
$b_R$


CG
W
Line of Gravity
Base
of support

# SIMPLE GAIT BIOMECHANICS

- A gait cycle begins when one-foot contacts the ground and ends when the same foot contacts the ground again.
- Main phases

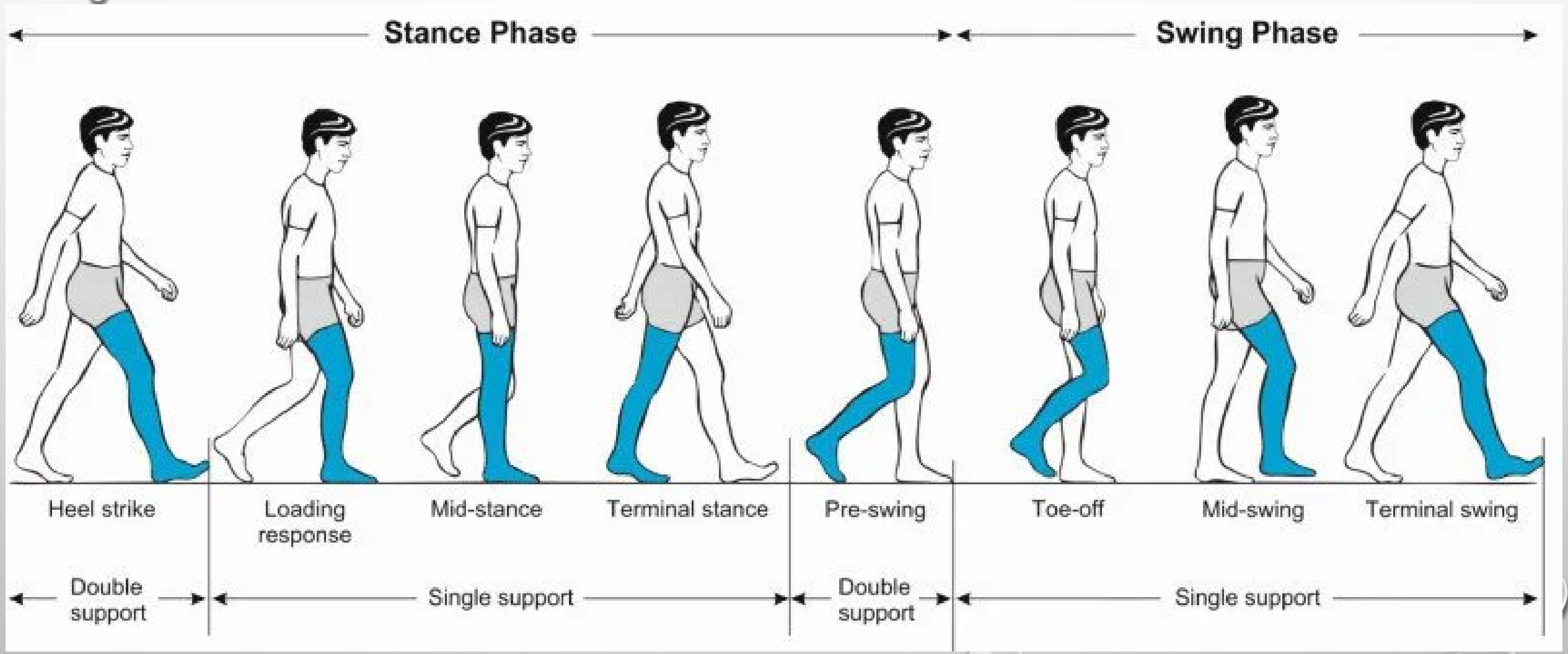
➢Stance phase: about 60%

➢Swing phase: about 40%

- During gait the body must remain stable, joints must move in a coordinated way, muscles must control loading and limb advancement, the GRF changes position through the gait cycle
- Why it matters in P&O:

➢Abnormal gait increases energy cost and fall risk

➢Prostheses and orthoses aim to improve gait safety and efficiency


Stance Phase
Swing Phase
Heel strike
Loading response
Mid-stance
Terminal stance
Pre-swing
Toe-off
Mid-swing
Terminal swing
Double support
Single support
Double support
Single support

# RELEVANCE TO PROSTHETICS

- In prosthetics, anatomy and biomechanics are essential for:

➢Selecting the proper prosthetic level and components

➢Understanding which biological function has been lost

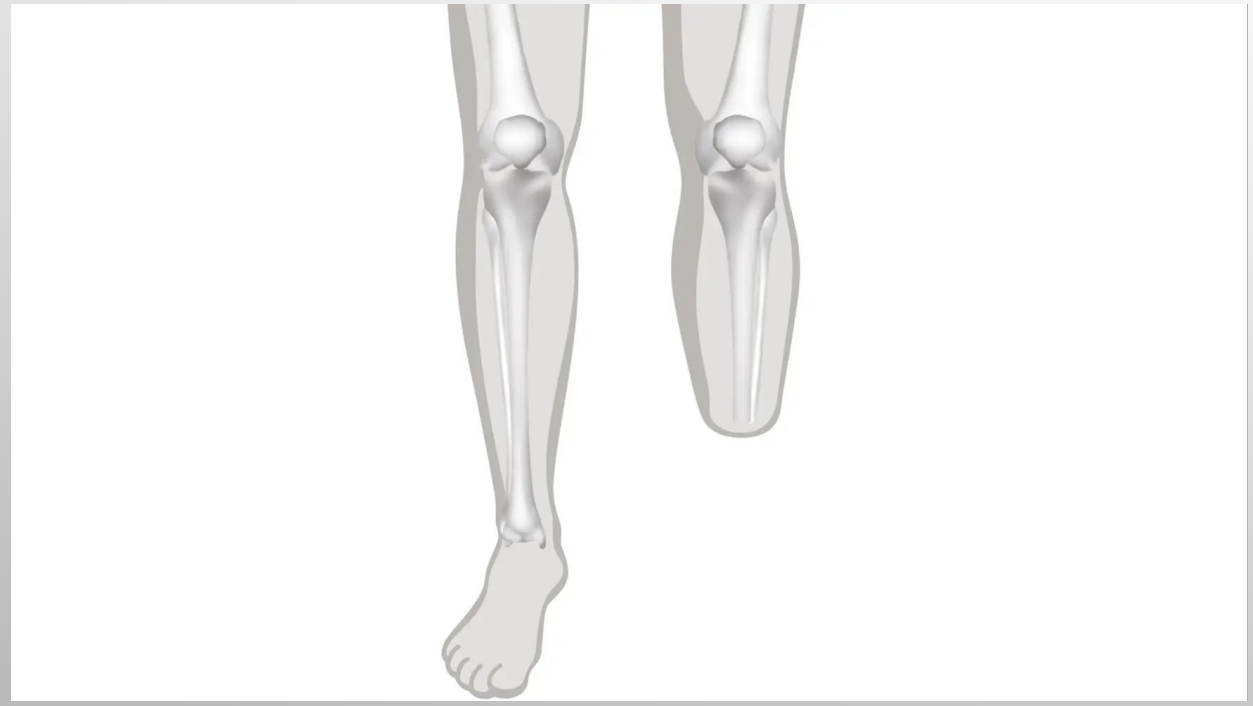
➢Planning socket load distribution

➢Aligning the prosthesis for stability and comfort

➢Reducing gait deviations

# CONT.

- Important examples
- In transtibial amputation, the prosthesis must replace many lost ankle-foot functions
- In transfemoral amputation, knee control and alignment become even more critical
- Socket fit matters because load must be transferred safely through the residual limb



# RELEVANCE TO ORTHOTICS

- In orthotics, anatomy and biomechanics help us decide:

➢Which segment needs support

➢Which joint motion should be allowed, limited, or blocked

➢How to improve alignment

➢How to reduce pain or abnormal loading

➢How to improve function during stance and swing

# CON.

- Important example: AFO
- Can support the ankle-foot complex
- Can improve toe clearance
- Can improve ankle and knee gait mechani
- Can reduce energy cost in selected patien

# CLINICAL BIOMECHANICAL RULES USEFUL FOR P&O SPECIALIST

- Rule 1: which joint or function is missing, weak, painful, or unstable?
- Rule 2: in which plane is the main problem? Sagittal, frontal, transverse
- Rule 3:what mechanical action is needed? Support, alignment, motion control, shock absorption, push-off assistance, load redistribution
- Rule 4: WHAT will happen during gait, not only during static standing?

# BASIC PATIENT ASSESSMENT IN PROSTHETICS AND ORTHOTICS

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# WHY PATIENT ASSESSMENT MATTERS

- Patient assessment is the foundation of good P&O care

➢Identifies the main problem

➢Determines the patient's functional limitations

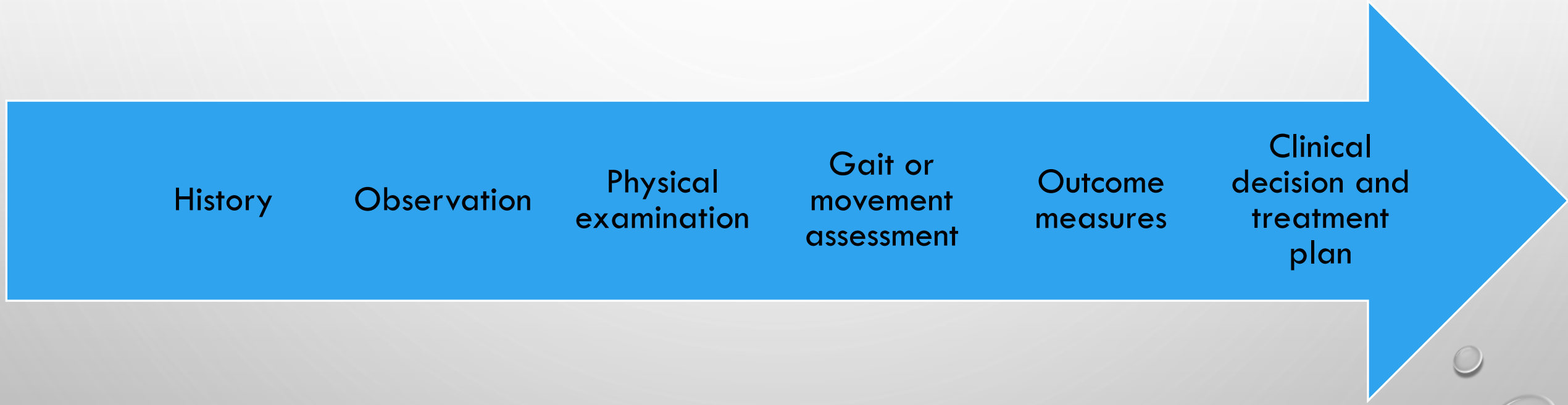
➢Helps select the most appropriate device

➢Supports safe and realistic treatment planning

➢Provides a baseline for follow-up

➢Improves patient-centered decision-making

# THE BASIC ASSESSMENT PATHWAY



# HISTORY TAKING

- diagnosis and medical history
- cause and duration of the problem
- cause and duration of the problem
- previous prosthesis or orthosis use
- pain history
- surgery history
- work and daily activity level

# OBSERVATION

- The first practical assessment method, before detailed examination, observe the patient for:

➢ Posture and overall alignment

➢ Limb position

➢ Body symmetry

➢ Swelling or deformity

➢ Skin color

➢ Muscle wasting

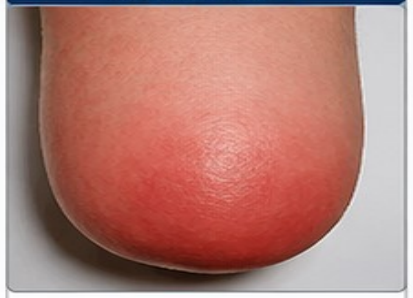
➢ Balance in standing

➢ Walking pattern

➢ Use of walking aids

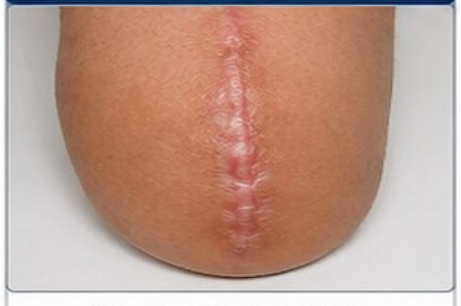
# SKIN AND SOFT TISSUE ASSESSMENT

### 1. Redness



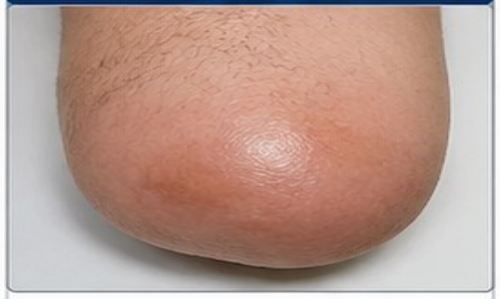
Red areas may indicate friction or pressure.

### 2. Scars



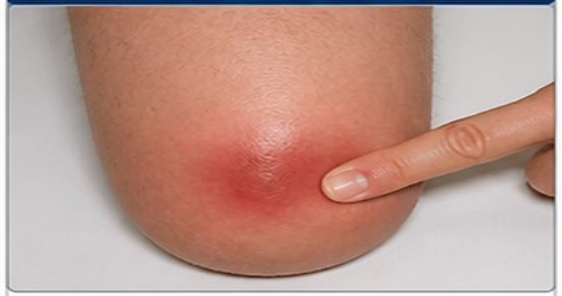
Check scar location, healing and mobility.

### 3. Edema



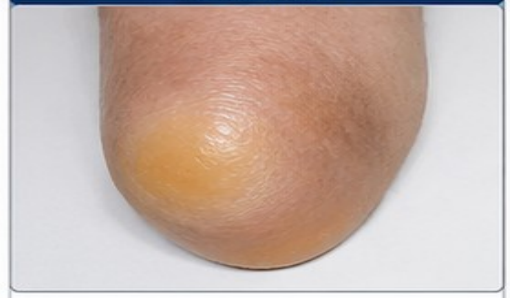
Swelling can affect fit and comfort.

### 4. Pressure areas



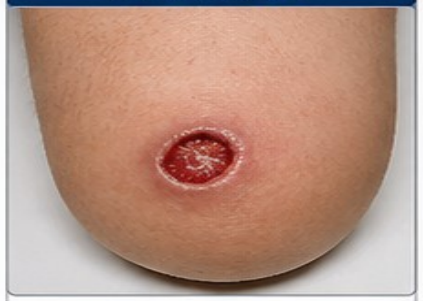
High pressure areas can lead to skin breakdown.

### 5. Callus



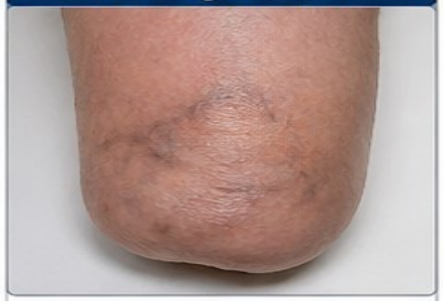
Thickened skin may indicate abnormal loading.

### 6. Wounds



Open wounds increase risk of infection and delay fitting.

### 7. Fragile skin

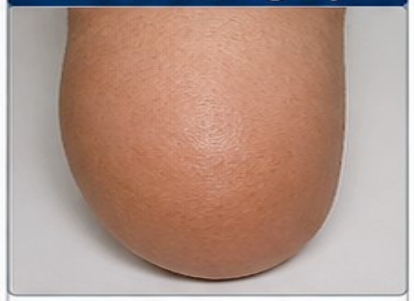


Fragile skin is more prone to injury and breakdown.

### 8. Skin temperature

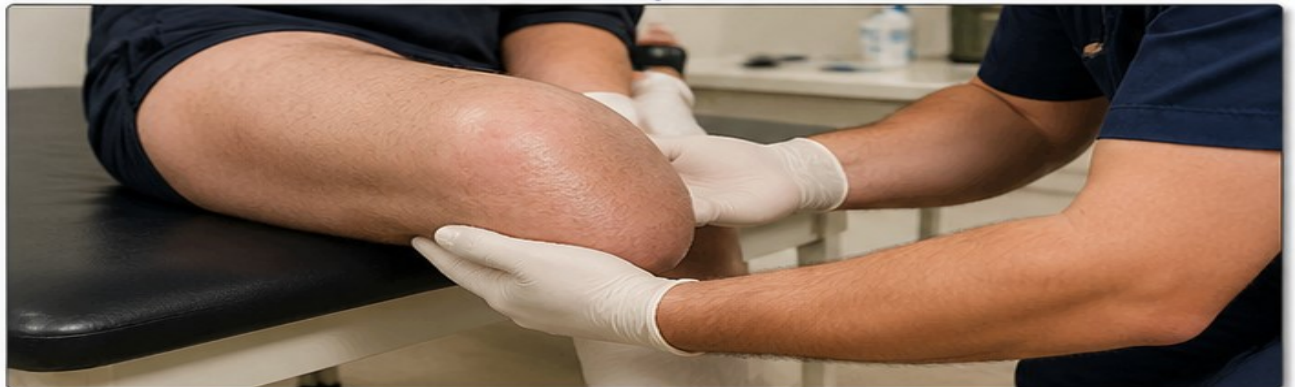
Compare both sides for temperature changes.

### 9. Skin integrity



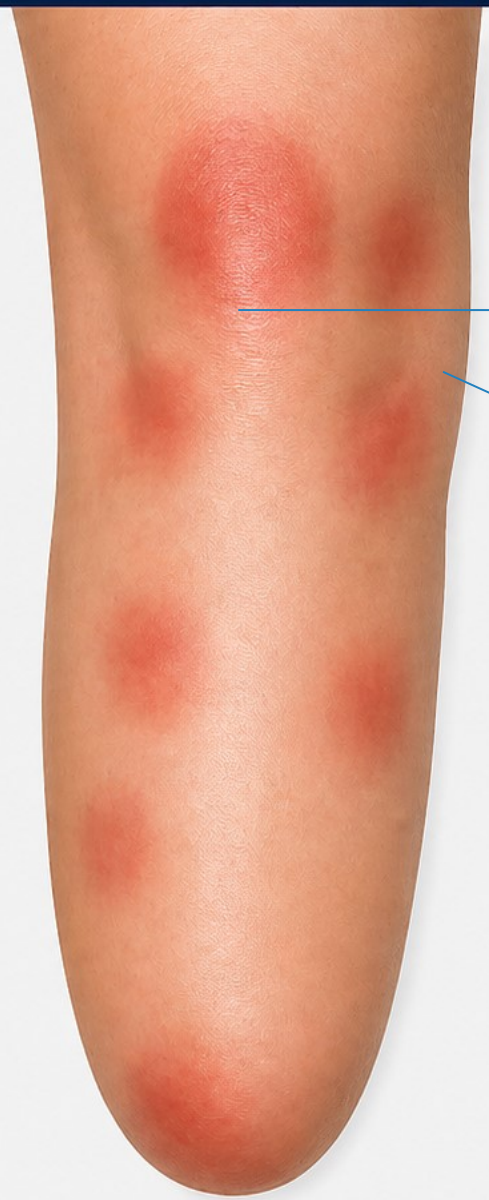
Healthy, intact skin supports better fitting and comfort.

### Residual limb inspection in clinic



### Assessment during orthotic evaluation

# Areas commonly at risk



Patella and patella tendon

Condyle

Tibia crest

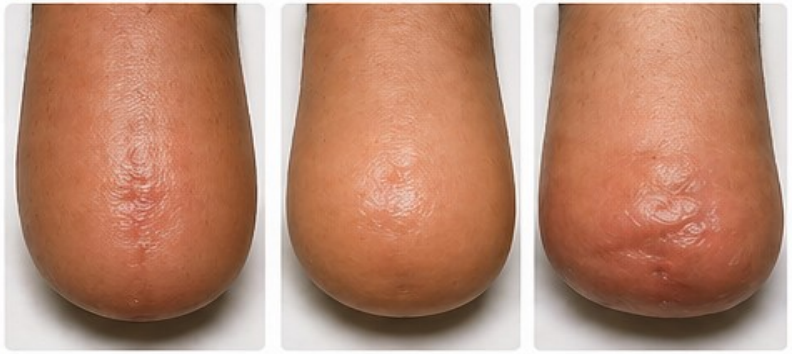
Distal end

# CONT.

- Why it matters
- Poor skin condition may limit device use
- High-pressure areas increase the risk of breakdown
- Skin findings affect fit, design, and follow-up

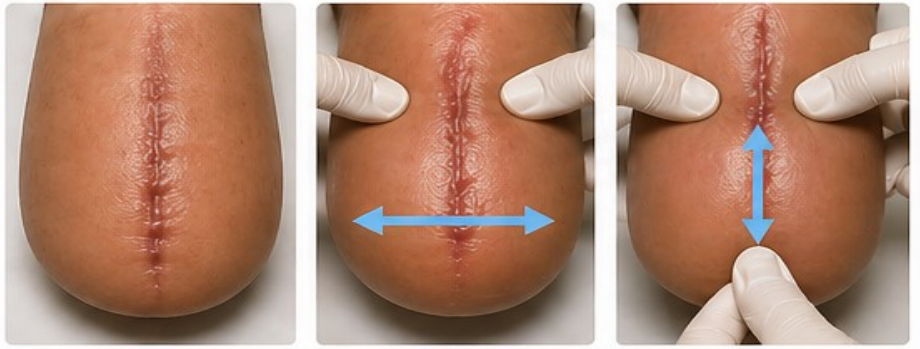
# RESIDUAL LIMB ASSESSMENT

## 1 Residual limb shape

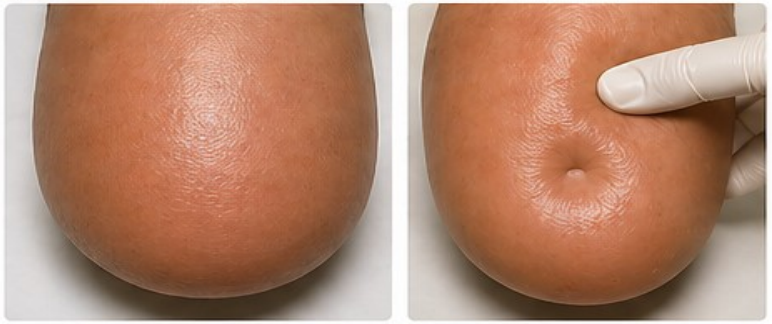


## 2 Residual limb length

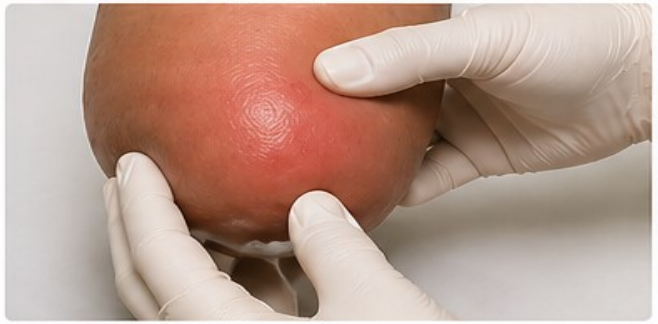
## 3 Scar mobility



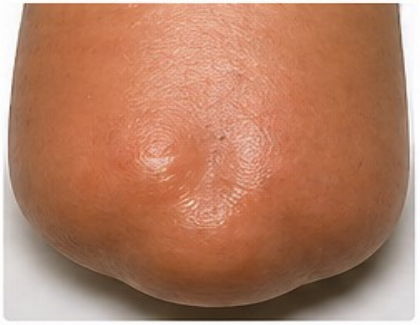
## 4 Edema



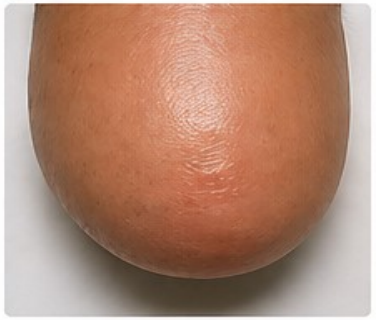
## 5 Tenderness



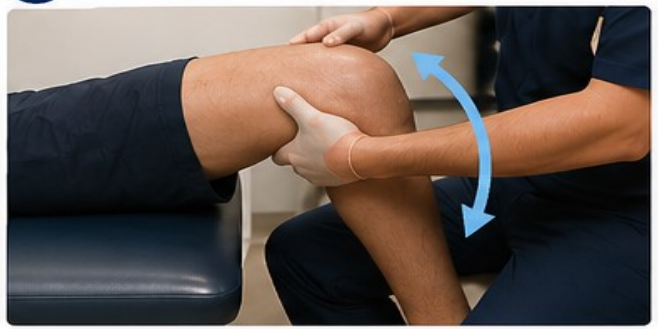
## 6 Bony prominences



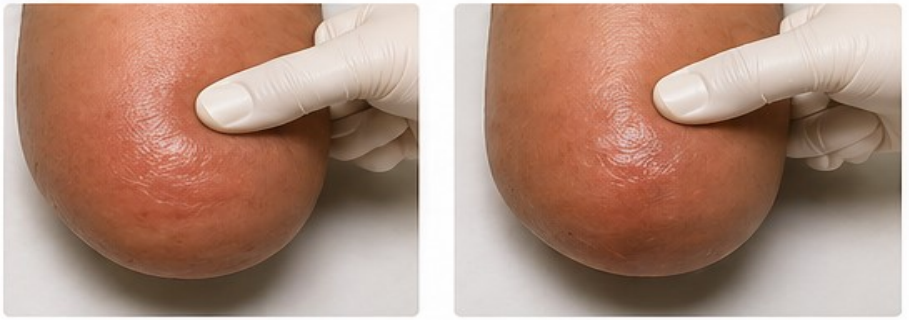
## 7 Soft tissue coverage




## 8 Contracture risk

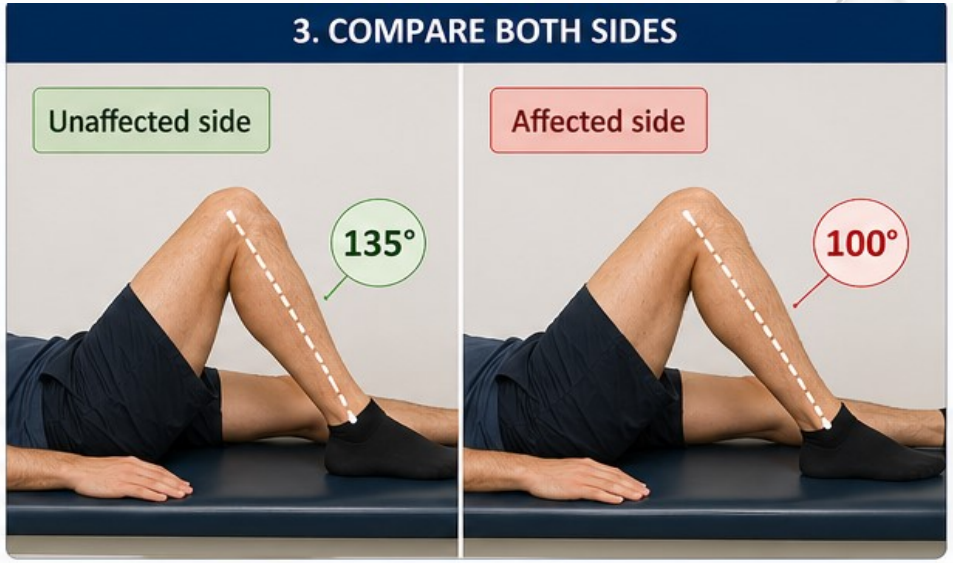


## 9 Tolerance to touch and pressure



# RANGE OF MOTION (ROM) ASSESSMENT






# CONT.

- Clinical importance
- Limited ROM may interfere with gait or function
- Contractures may prevent proper fitting
- Orthotic and prosthetic design depends on available motion
- ROM is explicitly listed as part of orthotic and prosthetic patient evaluation in P&O competency frameworks.

# MUSCLE STRENGTH ASSESSMENT

- Is the patient able to generate the force needed for function?, Method

➢ Manual muscle testing

➢ Compare right and left sides

➢ Identify weakness patterns

➢ Focus on muscles relevant to function

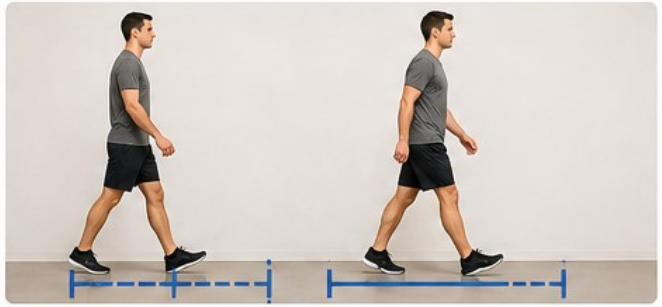
➢ Important muscle group

# CONT.

- Clinical importance
- Weakness may indicate need for support
- Muscle imbalance affects gait and posture
- Strength influences device choice and rehabilitation potential

# GAIT AND MOVEMENT ASSESSMENT

## 1 Step length



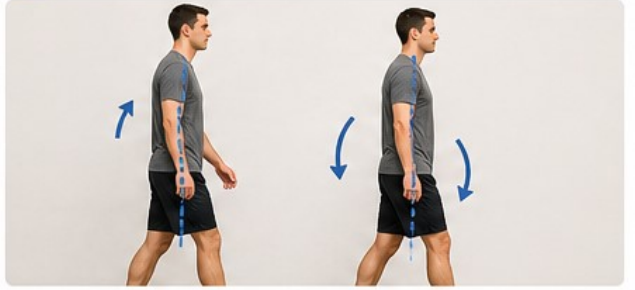
## 2 Symmetry

## 3 Cadence

## 4 Foot clearance

## 5 Knee stability

## 6 Trunk movement



## 7 Balance during stance

## 8 Use of assistive devices

# CONT.

- For prosthetic patients, Look for:
  - Uneven loading
  - Poor prosthetic control
  - Gait asymmetry
  - Inadequate knee or foot function
- For orthotic patients look for:
  - Instability
  - Abnormal joint motion
  - Compensatory patterns
  - Effect of the orthosis on walking

# CLINICAL DECISION-MAKING

- After assessment, the clinician decides:
  - Does the patient need a prosthesis or orthosis?
  - What type is most appropriate?
  - What are the treatment goals?
  - What are the main risks?
  - What outcome measures should be used?
  - What follow-up is needed?
- Good clinical decisions are based on:
  - Objective findings
  - Patient goals
  - Functional status
  - Evidence-based reasoning

# BASIC COMPONENTS OF PROSTHESES AND THEIR FUNCTIONS

ENG. HUSSEIN DHAMEER HUSSEIN

# WHAT IS A PROSTHESIS MADE OF

- Prosthesis is not one single part. It is a system of connected components that work together.
- Each prosthetic component has a specific role:

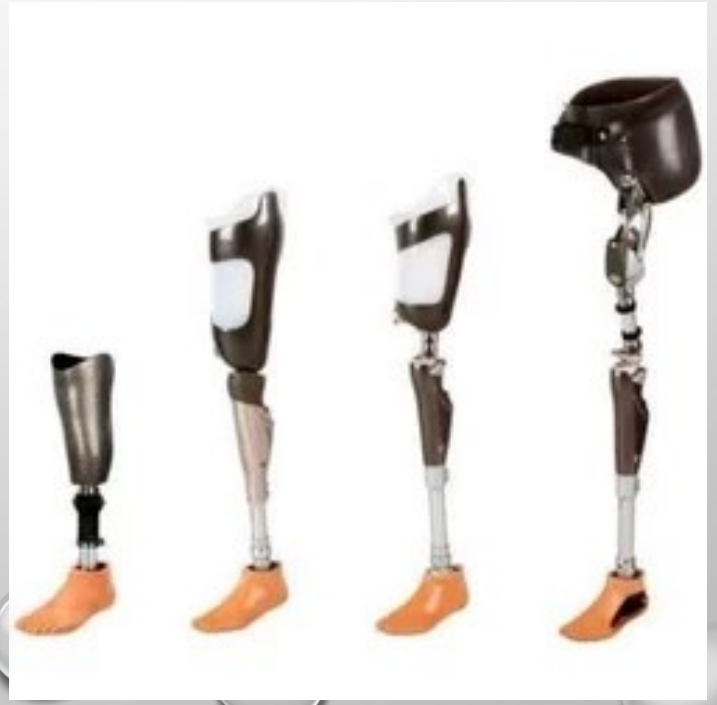
➢One part connects to the body

➢One part provides attachment

➢One part provides support

➢One part provides movement

➢One part provides function



# MAIN COMPONENTS OF A LOWER-LIMB PROSTHESIS

- The main components are:

➢Socket

➢Liner

➢Suspension system

➢Socket adapter

➢Pylon

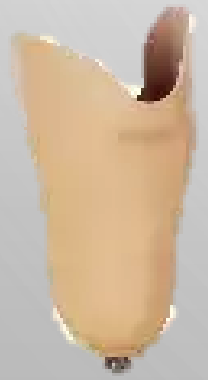
➢Prosthetic knee (in transfemoral prosthesis)

➢Prosthetic foot

➢Cosmetic cover (optional)

# SOCKET

- The socket is the part of the prosthesis that surrounds the residual limb.
- Function
  - ➢ Connects the residual limb to the prosthesis
  - ➢ Transfers load from the body to the prosthetic system
  - ➢ Provides control of the prosthesis
- Affects comfort and function more than any other part



# CONT.

- Socket design may vary depending on:

➢ Level of amputation

➢ Residual limb shape

➢ Soft tissue condition

➢ Suspension method

➢ Patient activity level

# LINER

- Liner is a soft interface worn between the residual limb and the socket.
- Function

➢Improves comfort

➢Reduces friction

➢Protects the skin

➢Helps suspension in some systems

➢Improves pressure distribution

- Common liner materials

➢Silicone

➢Gel

# SUSPENSION SYSTEM

- The suspension system keeps the prosthesis attached to the residual limb.
- Function

➢Prevents the prosthesis from falling off

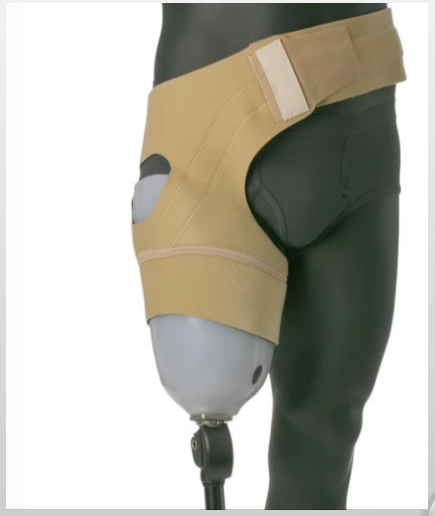
➢Improves control during walking

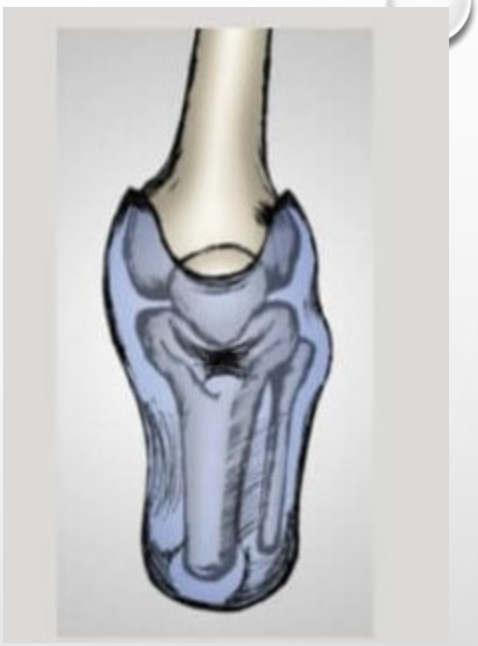
➢Reduces pistoning

➢Improves confidence and stability

# CONT.

- Common suspension methods
  - ➢Supracondylar suspension
  - ➢Sleeve suspension
  - ➢Pin-lock system
  - ➢Suction suspension
  - ➢Vacuum suspension
  - ➢Belts or straps in some cases





# SOCKET ADAPTER

- This is the part that connects the socket to the rest of the prosthesis.
- Function
  - ➢ Joins the socket to other components
  - ➢ Allows alignment adjustment
  - ➢ Helps connect the socket to the pylon or knee unit

- Examples
- Pyramid adapter
- Rotating adapter
- Alignment connector


# PYLON

- The pylon is the structural support between the socket or knee unit and the foot.
- Function

➢Supports body weight

➢Connects upper and lower prosthetic parts

➢Helps maintain length

➢Provides structural stability

# PROSTHETIC KNEE UNIT

- Used in transfemoral prosthesis
- Function
  - ➢Helps stance stability
  - ➢Helps sitting
  - ➢Helps smoother walking
- Basic mechanism
  - ➢Single-axis knee
  - ➢Polycentric knee


# CONT.

- Types
  - ➢Manual-lock knee
  - ➢Stance-control knee
  - ➢Microprocessor knee
  - ➢Hydraulic knee

# PROSTHETIC FOOT

- The prosthetic foot is the terminal lower part of the prosthesis.
- Function

➢Provides support during standing

➢Absorbs shock

➢Helps forward progression

➢Improves balance

➢Contributes to toe clearance and rollover

# CONT.

- Common types
  - SACH foot
  - Single-axis foot
  - Dynamic response foot
  - Energy-storing food


# COSMETIC COVER

- A cosmetic cover is an outer cover used to improve appearance.
- Function

➢Improves cosmetic look

➢May protect internal components

➢May improve patient satisfaction

# COMMON PROBLEMS RELATED TO PROSTHETIC COMPONENTS

- Poor socket fit → pain, skin breakdown, poor control
- Poor suspension → pistoning, instability
- Poor alignment → gait deviation
- Unsuitable foot → poor rollover, poor balance
- Unsuitable knee unit → unsafe walking
- Poor liner use → friction or skin problem

# K LEVELS IN LOWER-LIMB PROSTHETICS

- K levels describe the patient's expected functional potential with a lower-limb prosthesis.
- K0: no ability or potential to walk safely with a prosthesis
- K1: ability for transfers or walking on level surfaces at a fixed cadence
- K2: ability for limited community walking and simple obstacles such as curbs or stairs
- K3: ability for community walking with variable cadence
- K4: ability for high activity beyond basic walking, such as athletics or very active work

# K LEVELS FOR PROSTHETICS

K-Level 0

K-Level 1

K-Level 2

K-Level 3

K-Level 4

PRIMECARE
Orthotics & Prosthetics

# BASIC COMPONENTS OF ORTHOSES AND THEIR FUNCTIONS

ENG. HUSSEIN DHAMEER HUSSEIN

# WHAT IS AN ORTHOSIS MADE OF

- An orthosis is not a single piece only. It is usually a combination of functional parts that work together to:

➢support a body segment

➢control or guide motion

➢reduce pain

➢protect tissues

➢improve function

# MAIN COMPONENTS OF LOWER-LIMB ORTHOSES

- Common components
- foot plate
- Uprights
- ankle joint
- calf section / calf shell
- Straps
- Pads
- knee joint in KAFO
- thigh band in KAFO
- pelvic section in HKAFO when needed

# FOOT PLATE

- The foot plate is the part under the foot inside the shoe or attached to the orthosis.
- Function

➢Supports the foot

➢Helps position the foot

➢Helps control alignment

➢Provides A base for force transfer

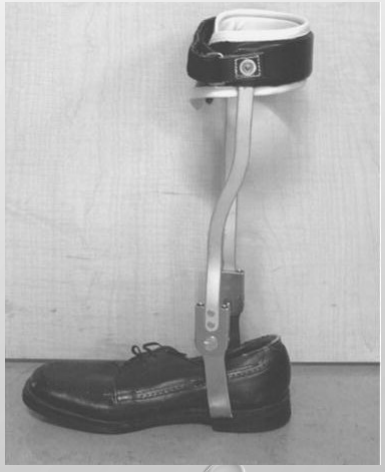
➢May help redistribute pressure

# UPRIGHTS

- Uprights are the vertical side bars of an orthosis, usually medial and lateral.
- Function
- Connect upper and lower parts of the orthosis
- Provide structural support
- Control motion
- Help transfer forces along the device

# ANKLE JOINT

- The orthotic ankle joint is the hinge or control mechanism at the ankle level.
- Function
  - ➢ May allow motion
  - ➢ May limit motion
  - ➢ May block motion
  - ➢ Helps control plantarflexion and dorsiflexion
  - ➢ Influences gait mechanics



# CALF BAND / CALF SHELL

- This is the part that contacts the lower leg.
- Function
  - ➢ stabilizes the tibia
  - ➢ helps control leg position over the foot
  - ➢ improves force transmission
  - ➢ increases orthotic control
- clinical point
- a larger anterior or posterior shell can increase control, especially in more rigid orthoses

# STRAPS

- Straps are fastening parts used to hold the limb inside the orthosis.
- Function
  - ➢ Secure the device
  - ➢ Reduce unwanted movement inside the orthosis
  - ➢ Improve control
  - ➢ Keep the foot or limb in position
- Clinical point
- Poor strapping can reduce the effectiveness of the whole orthosis

# PADS

- Pads are soft cushioning materials placed in selected areas of the orthosis.
- Function

➢Improve comfort

➢Reduce local pressure

➢Protect bony prominences

➢Help distribute force more safely

# KNEE JOINT AND THIGH BAND (IN KAFO)

- In a KAFO, the knee joint may:

➢ Allow knee flexion and extension

➢ Lock the knee

➢ Guide movement

➢ Improve stance stability

# CONT.

- The thigh band helps:
  - Support the femoral segment
  - Improve fit
  - Improve control above the knee

# HOW ORTHOTIC COMPONENTS AFFECT FUNCTION

- A better foot plate can improve support
- A better strap system can improve control
- A better joint choice can improve motion control
- Better pads can improve comfort
- A stronger shell can improve stability

# COMMON PROBLEMS RELATED TO ORTHOTIC COMPONENTS

- Poor strap placement → poor control
- Poor padding → pressure and discomfort
- Poor joint choice → too much or too little motion
- Poor shell design → insufficient support
- Poor foot plate design → poor load transfer or poor comfort