Al-Mustaqbal University

Collage of Engineering

Prosthetics and Orthotics Engineering

Third Stage

PROSTHETICS II

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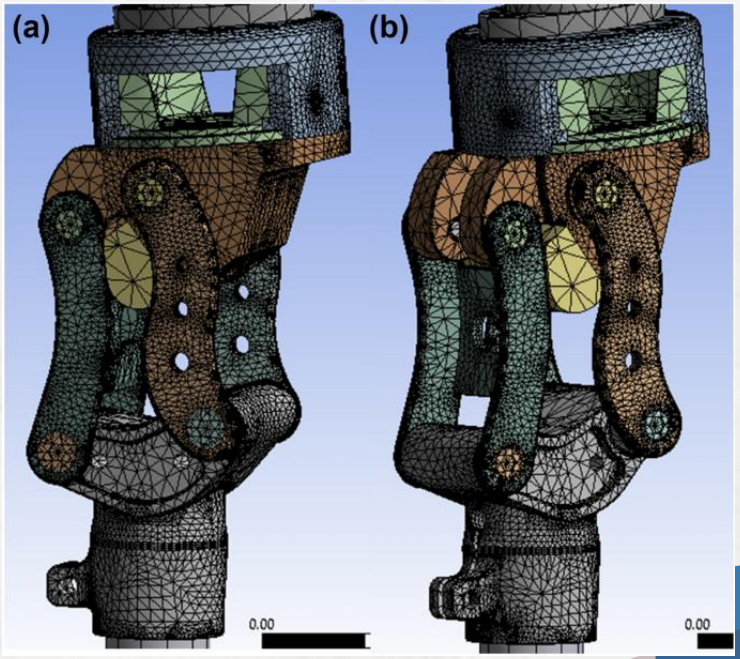


1

Transfemoral Prosthesis Suspension Methods

1- Self-Suspension:

The prosthesis is suspended by the shape and contour of the socket itself, without the need for straps or belts.

Advantages:

- Simple and easy to use.
- No external suspension components required.

Disadvantages:

- Limited applicability to certain socket designs.
- May provide less secure suspension compared to other methods.

2

Suspension Methods

2- Suction Socket:

A closely fitted socket where soft tissue is drawn inside as the patient pulls a sock through a distal opening. The opening is sealed with a plug or valve, creating a vacuum that secures the socket.

Advantages:

- No additional straps are needed.
- Provides better cosmetic appearance.
- Offers firm suspension when properly fitted.

Disadvantages:

- Requires highly accurate fitting and multiple check sockets.
- Perspiration may accumulate due to the absence of a liner.
- Suction may be lost in the sitting position, even with a good fit.

3

Suspension Methods

3- Silicone Sleeve Suspension:

A silicone sleeve is rolled onto the residual limb, ensuring that no air remains between the sleeve and the skin, which creates a vacuum effect. The sleeve is then attached to the distal end of the socket using either a pin-and-ratchet mechanism or a lanyard system. This provides secure suspension by firmly connecting the prosthesis to the silicone sleeve.

Advantages:

- Eliminates the need for straps, avoiding skin irritation and restriction of movement.
- Provides very secure and reliable suspension.

Disadvantages:

- High cost compared to other suspension systems.
- Perspiration may cause discomfort as there is no sock to absorb sweat.
- Donning and doffing the silicone sleeve can be difficult, especially for patients with limited hand function or poor

4

Suspension Methods

4- Silesian Belt:

The Silesian belt is a simple suspension belt made from leather or nylon webbing. Its primary function is to suspend the prosthesis on the residual limb (stump). The belt is attached to the socket in a way that allows it to swivel during sitting and walking, ensuring comfort and mobility.

Advantages:

- Provides secure suspension without restricting movement.
- Simple to fit and easy to repair.
- Can be fabricated from locally available materials.
- Improves medio-lateral stability of the prosthesis.

Disadvantages:

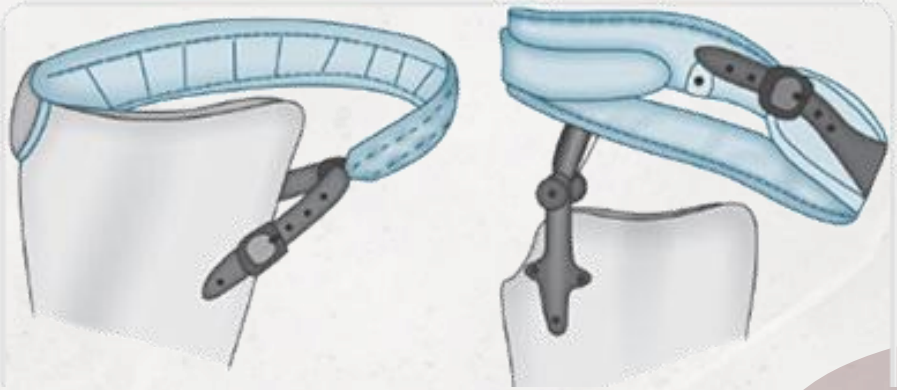
- Incorrect adjustment may cause internal rotation of the socket.
- May be visible through clothing, affecting aesthetics.
- Proper adjustment of the Silesian belt should be included in both static and dynamic alignment procedures.

5

Suspension Methods

5- Rigid Pelvic Band:

The rigid pelvic band consists of a single-axis hip joint and a pelvic band, typically covered with leather or cloth to enhance comfort. It provides additional stability, particularly medio-lateral stability in the pelvic region, and also improves rotational control of the prosthesis.



Advantages:

- Increases medio-lateral (ML) pelvic stability.
- Enhances rotational stability of the prosthesis.

Disadvantages:

- Adds extra weight to the prosthesis.
- Bulky design and less aesthetically appealing.

Knee Joint Types

There are two main types of prosthetic knee joints:

Single-Axis Knee

Polycentric Knee

Knee Joint Types

Single-Axis Knee:

The single-axis knee consists of a simple hinge mechanism that allows flexion and extension in one plane.

Features:

- Provides basic knee movement for walking.
- Offers stability during the stance phase due to its mechanical simplicity.
- Easy to manufacture and maintain, making it cost-effective.

Limitations:

- Does not mimic the natural knee motion perfectly.
- Less stability during high-demand activities such as running or stair climbing.
- Limited ability to adjust for variable walking speeds.

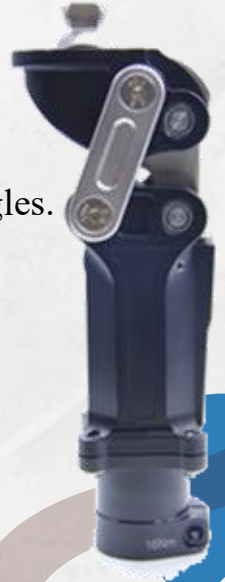
Knee Joint Types

Polycentric Knee:

The polycentric knee features a changing center of rotation as the knee flexes and extends, closely mimicking the natural motion of the human knee.

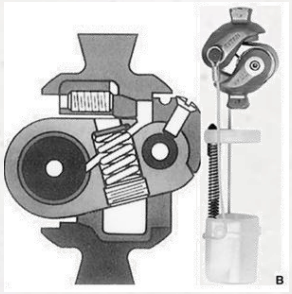
Features:

- Most commonly uses a 4-bar linkage system, allowing the center of rotation to shift at different flexion angles.
- Provides more natural and smooth knee motion during walking.
- Enhances stability during the stance phase and improves swing phase control.
- Can better accommodate variable walking speeds and high-demand activities.



Knee Phase Control Mechanisms

Prosthetic knees are designed to provide **stability** during stance and **control** during swing. The mechanisms vary in complexity, but their main purpose is to allow safe and efficient walking for transfemoral amputees.



Stance Phase Stability:

•Ensures the knee does not buckle during weight-bearing.

•Mechanisms include:

1. **No Lock:** Relies on alignment and patient's own muscles.
2. **Manual Lock:** Knee can be locked in extension when standing and unlocked when sitting.
3. **Weight-Activated Stance Control:** A brake engages when weight is applied to prevent flexion.
4. **Hydraulic Stance Control:** A hydraulic cylinder provides adjustable resistance to maintain stability.

Knee Phase Control Mechanisms

Swing Phase Control:

•Ensures smooth knee flexion and extension during leg swing.

•Mechanisms include:

1. **Free Knee:** No control; relies on pendulum motion (slower, uneven gait).
2. **Locked Knee:** Knee remains extended; patient compensates by vaulting or lateral trunk movement.
3. **Friction Control:** Mechanical friction resists knee flexion, suitable for one walking speed.
4. **Mechanical Extension Aid:** Elastic band or spring propels the shank into extension at the end of swing.
5. **Pneumatic/Hydraulic Control:** Provides variable resistance that adapts to walking speed; flexion and extension can be independently adjusted.


Thank
you