Al-Mustaqbal University

Collage of Engineering

Prosthetics and Orthotics Engineering

Third Stage

PROSTHETICS II

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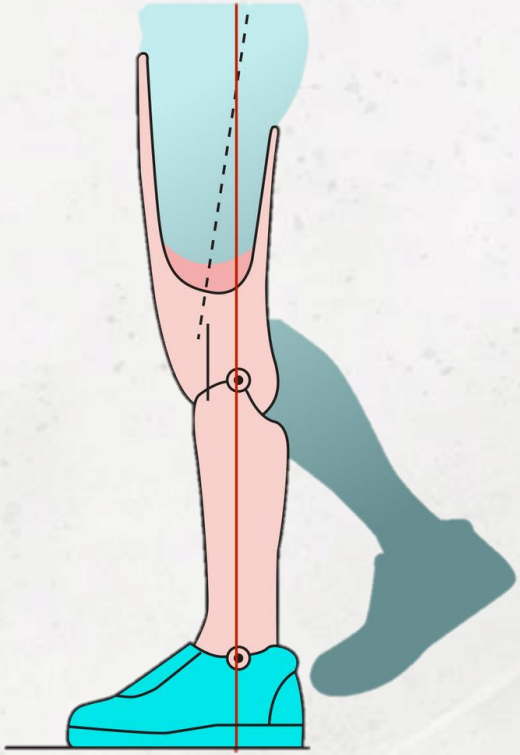

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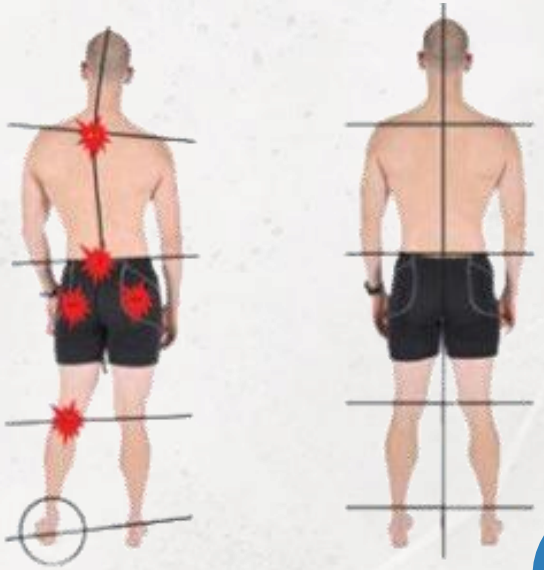
Prosthetic Alignment

Alignment: is the precise spatial relationship between the prosthetic socket, the prosthetic foot, and all other components (like the knee unit).

Poor alignment leads to:

- An abnormal and strenuous gait.
- Instability and a feeling of being unsafe.
- A massive increase in the patient's energy expenditure.
- Discomfort and painful pressure points.



✓ The goal is to achieve a perfect balance between **Stability** and **Mobility**.

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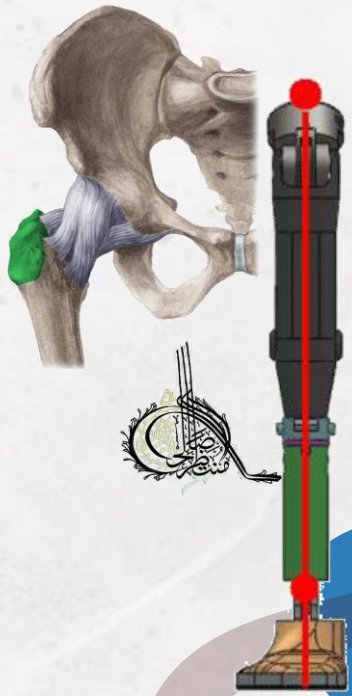
Goals & Principle of Alignment

Core Goals of Alignment:

- **Safety First:** Provide complete knee and hip stability during the Stance Phase.
- **Efficiency:** Minimize the patient's energy consumption and create a smooth, natural motion.
- **Comfort:** Distribute loads and pressures evenly within the socket.
- **Cosmesis:** Ensure the prosthesis looks natural under clothing during standing and walking.



The Governing Principle: The TKA Line

A theoretical line running from the Trochanter, through the Knee center, to the Ankle center.

The position of this line relative to the joints determines the stability of the prosthesis.

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Bench Alignment

This is the initial setup performed in the workshop before the patient wears the prosthesis.

It serves as the "default setting" based on standard biomechanical principles.

Basic Steps:

1- Foot Placement: The prosthetic foot is fixed in the jig with the correct heel height for the patient's shoe.

2- Component Assembly: The pylon and knee unit are attached.

3- Socket Attachment:

- An Initial Flexion angle is set.
- An Initial Adduction angle is set.

This alignment is only a starting point and will be refined during the dynamic fitting.

Alignment for TF & KD

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In the Sagittal Plane (Side View):

TKA Line: Must pass anterior to the knee joint's **center of rotation**.

Why? To create an "extension moment" that prevents the knee from buckling during weight-bearing, ensuring safety.

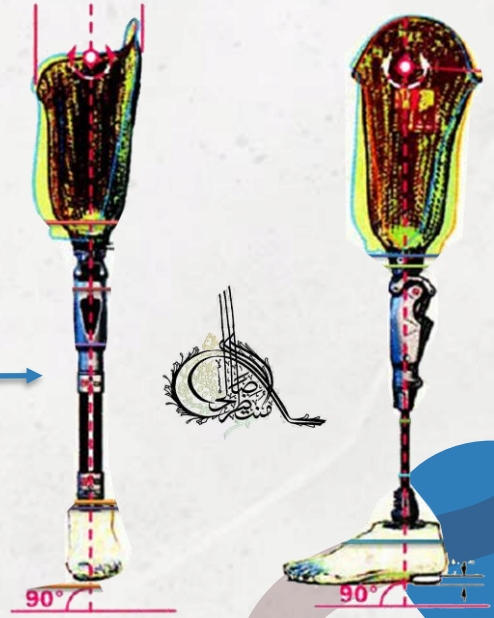
Socket: Set in 5-10 degrees of **initial flexion**.

Why? To help the patient engage their hip extensors and to provide a comfortable seating surface.

In the Frontal Plane (Front View):

Socket: Set in 5-7 degrees of **initial adduction**.

Why? To mimic the natural angle of the femur, effectively engage the Gluteus Medius muscle, and prevent hip drop during gait.



Alignment for HD & HP

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Double Stability:

The alignment must ensure the stability of both the prosthetic hip and knee joints simultaneously.

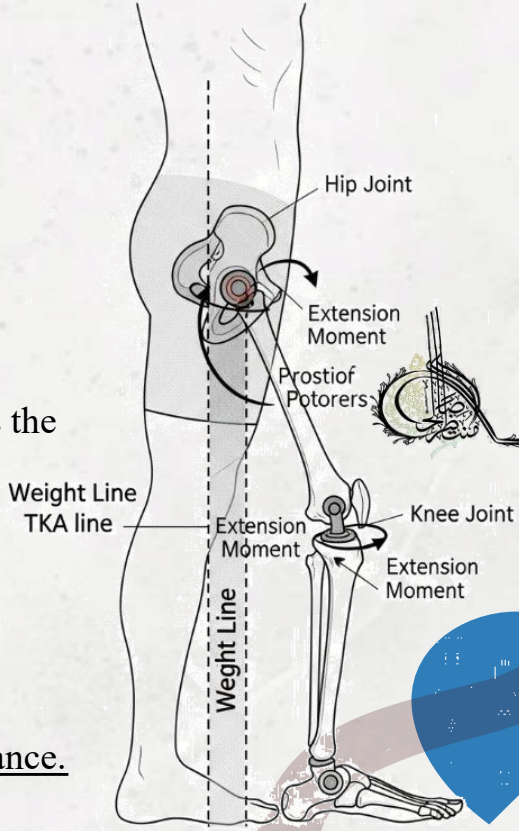
How is this achieved?

The joints are arranged in a "Zig-Zag" so the weight line provides stability:

Prosthetic Hip Joint: Positioned so the weight line falls **posterior** to its axis. This forces the hip joint into extension, making it stable.

Prosthetic Knee Joint: Positioned so the weight line falls **anterior** to its axis. This forces the knee joint into extension, making it stable.

<u>In this way, the patient's own body weight "locks" both joints in a safe position during stance.</u>



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Dynamic Alignment

The Real-World Test. This is the final fine-tuning stage, performed while observing the patient walk. This is where engineering theory becomes a clinical art.

The Process:

Observe ➡️ Identify Deviation ➡️ Hypothesize Cause ➡️ Make Adjustment ➡️ Re-observe

Common Examples:

Deviation: Knee is unstable and buckles.

Potential Adjustment: Move the socket slightly forward to shift the TKA line more anterior to the knee.

Deviation: Lateral trunk bending (patient leans to the side).

Potential Adjustment: Increase socket adduction or check if the prosthesis is too long.

Deviation: Circumduction (swinging the leg in an arc).

Potential Adjustment: Check if the prosthesis is too long or if knee flexion is restricted.


Thank
you