



# Gait and Prosthetic Alignment

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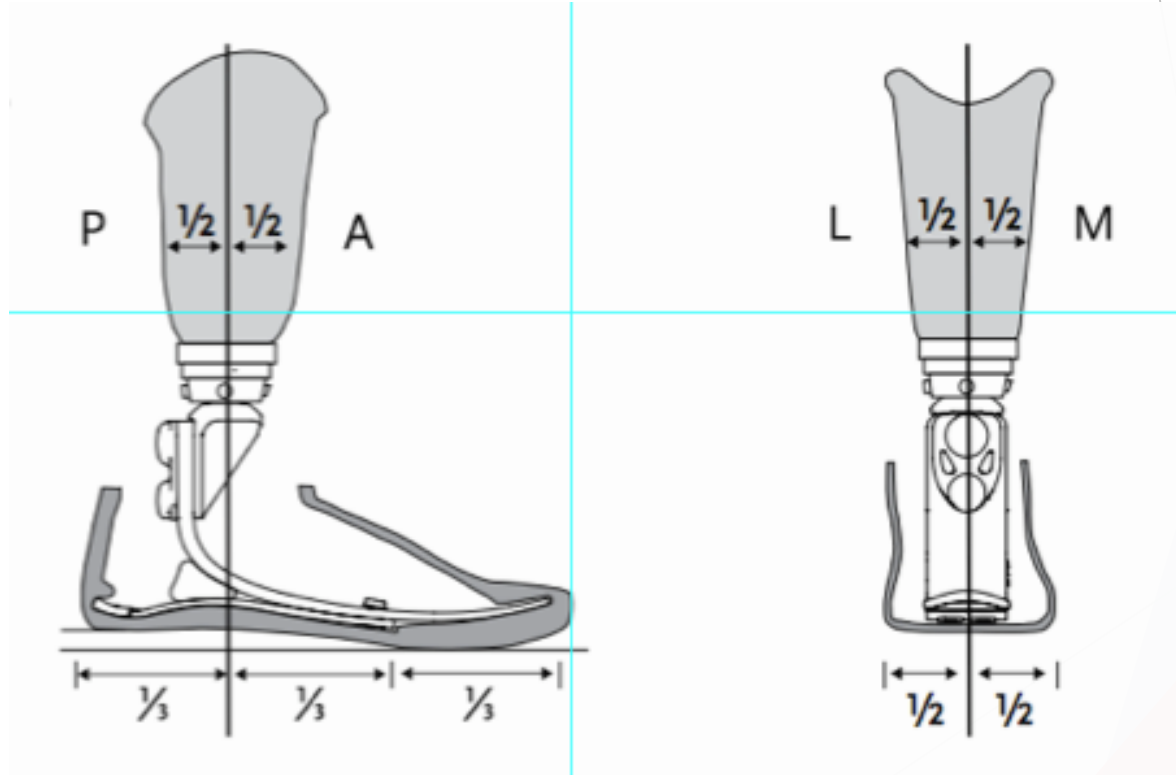
# Presentation Outline

- Transtibial
  - Static Alignment
  - Dynamic Gait Deviations
  - Videos
- Transfemoral
  - Static Alignment
  - Dynamic Gait Deviations
  - Videos
- Questions



Transtibial

# Transtibial Static Alignment



# Initial Contact



<b>Deviation</b>	<b>Possible Cause</b>
Knee too extended	<ul style="list-style-type: none"><li>• Faulty Suspension</li><li>• Insufficient pre-flexion of the socket</li><li>• Foot too anterior</li></ul>
Knee too flexed	<ul style="list-style-type: none"><li>• Faulty suspension</li><li>• Flexion Contracture</li></ul>
Unequal stride length	<ul style="list-style-type: none"><li>• Foot too posterior/anterior</li><li>• Poor gait training</li></ul>

# Loading Response



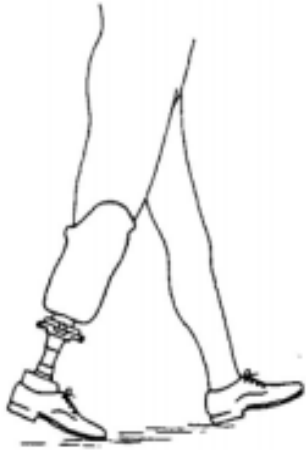
Deviation	Possible Cause
<p>Knee remains extended and patient “rides” the heel</p> <p>“Crushing” the heel</p>	<ul style="list-style-type: none"><li>● Foot too anterior</li><li>● Socket too extended, Foot too plantarflexed</li><li>● Prosthetic foot heel too soft (requires a bumper)</li><li>● Heel on shoe too low</li><li>● Poor gait training</li></ul>
<p>Knee flexion is abrupt, instability with knee buckling</p>	<ul style="list-style-type: none"><li>● Weak quadriceps</li><li>● Foot too posterior</li><li>● Socket too flexed, Foot too dorsiflexed</li><li>● Heel on shoe is too stiff or too high</li><li>● Prosthetic foot bumper or heel wedge too firm</li></ul>
<p>Foot Slap (may be present on hydraulic feet)</p>	<ul style="list-style-type: none"><li>● Plantarflexion resistance too soft</li><li>● Incorrect foot category (weight gain)</li></ul>

# Midstance



Deviation	Possible Cause
Pylon leans medially	<ul style="list-style-type: none"><li>• Too much socket adduction</li><li>• Foot too outset</li></ul>
Pylon leans laterally	<ul style="list-style-type: none"><li>• Not enough adduction</li><li>• Foot too inset</li></ul>
Too much or too little varus moment	<ul style="list-style-type: none"><li>• Too much - foot too inset</li><li>• Too little - foot too outset</li></ul>
Feet too close or too far apart	<ul style="list-style-type: none"><li>• Too close - foot too inset</li><li>• Too far - foot too outset</li><li>• Gait training needed</li></ul>
Lateral trunk bending to the prosthetic side	<ul style="list-style-type: none"><li>• Prosthesis height incorrect</li><li>• Residual limb pain</li><li>• Foot too outset</li></ul>

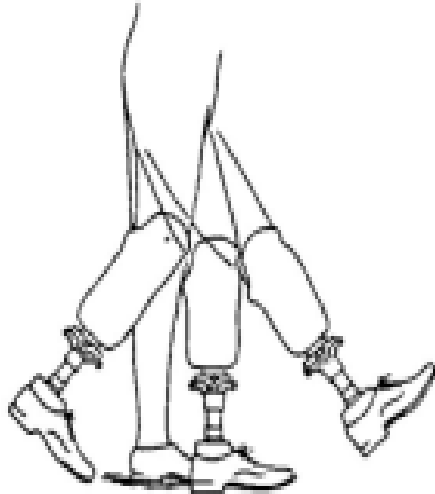
# Terminal Stance and Pre-swing



Deviation	Possible Cause
Heel off occurs too early and patient “Drops offs” too quickly onto the sound side	<ul style="list-style-type: none"><li>• Foot too posterior</li><li>• Foot too Dorsiflexed</li></ul>
Heel off is delayed, might see hyperextension	<ul style="list-style-type: none"><li>• Foot too anterior</li><li>• Foot too plantarflexed</li></ul>
Socket drops away from the patient	<ul style="list-style-type: none"><li>• Suspension too loose</li></ul>



# Swing



Deviation	Possible Cause
Foot “whips” medial or lateral during initial swing	<ul style="list-style-type: none"><li>• Socket rotated on the patient</li></ul>
Prosthetic foot hits the ground	<ul style="list-style-type: none"><li>• Prosthesis is too long</li><li>• Suspension is loose</li><li>• Knee flexion limited</li><li>• Muscle weakness, gait training</li></ul>

# Patient says....

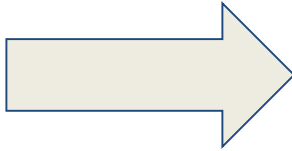
“I feel like I’m walking down a hill”

“My knee feels like it wants buckle”

“I can’t straighten my knee”

“I changed to a dress shoe or boot”

“I’m being thrown forward”



- Socket too flexed
- Foot too dorsiflexed
- Foot too posterior
- Prosthetic foot heel bumper too firm
- Patient shoe heel too firm or too high

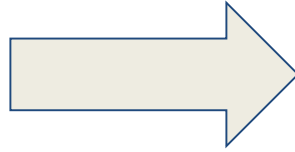
# Patient says...

“I feel like I’m walking up a hill”

“I can’t bend my knee”

“I changed my shoe to a flat or a converse”

“I’m falling backwards”



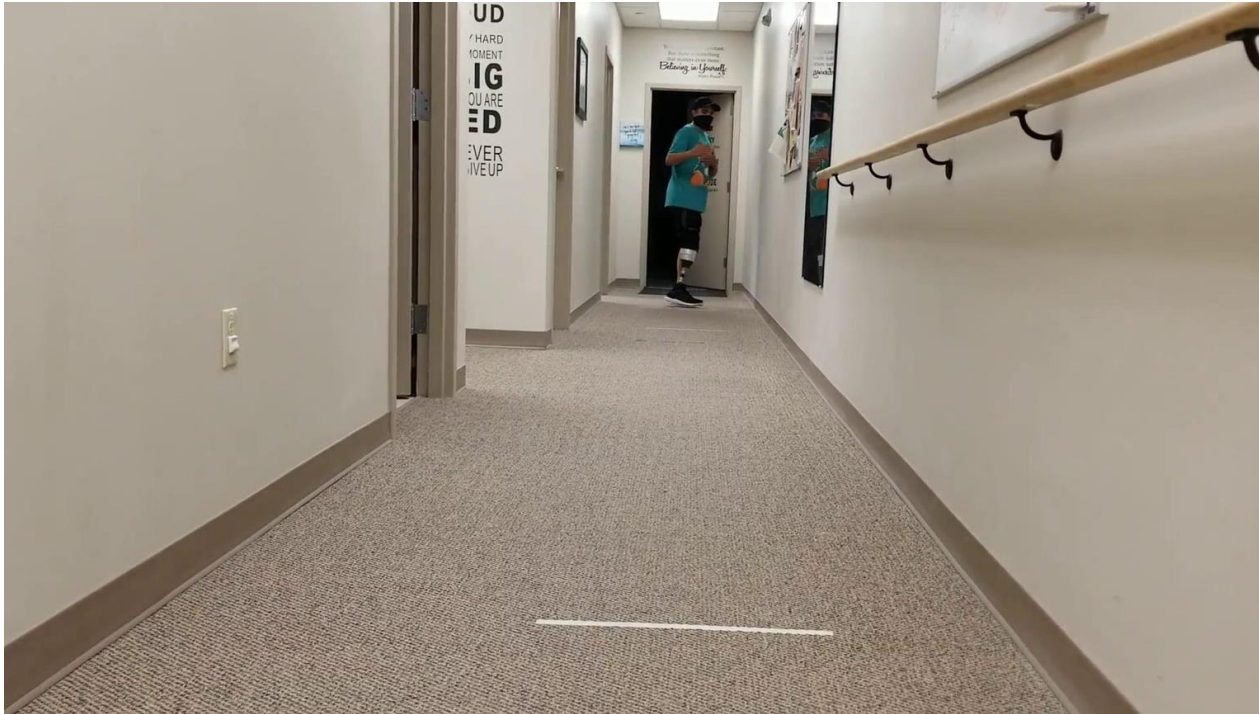
- Socket too extended
- Foot too plantarflexed
- Foot too anterior
- Prosthetic foot heel bumper too soft
- Patient shoe heel too soft or too low

# Transtibial Gait Videos

# 1. What is the deviation?



## 2. What is the deviation?



### 3. What is the deviation?





## 4. What is the deviation?





## 5. What is the deviation?



## 6. What is the deviation?

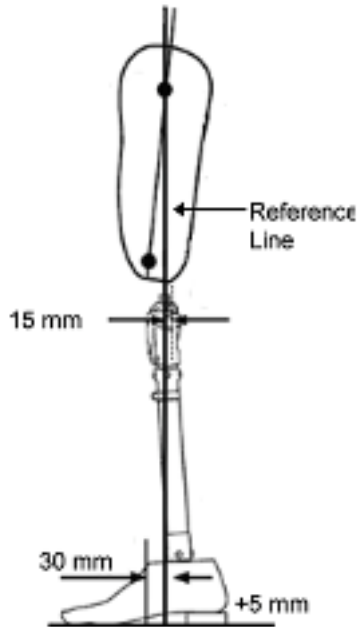


The background features abstract, overlapping geometric shapes in shades of red and blue. A prominent red shape is on the right side, partially overlapping a blue shape. The shapes are semi-transparent, creating a layered effect. The overall composition is modern and minimalist.

Transfemoral

# Transfemoral Static Alignment

TKA Line – Line drawn through anatomical trochanter, prosthetic knee center and prosthetic ankle

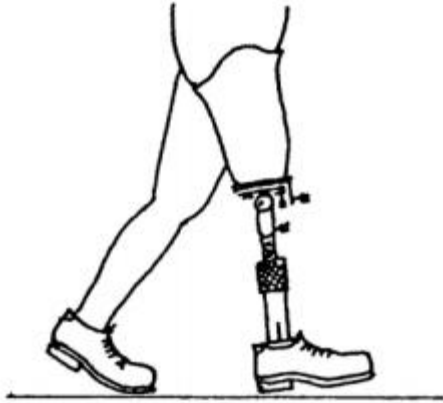


# Initial Contact



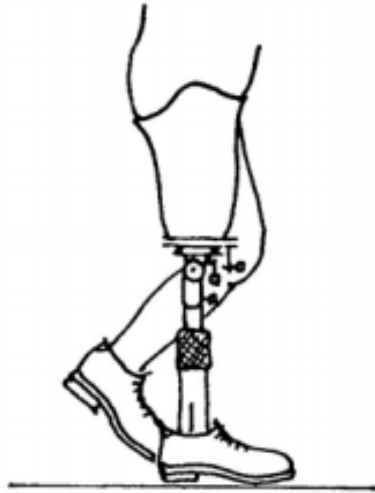
Deviation	Possible Cause
Knee Instability – Knee flexes	<ul style="list-style-type: none"><li>• Knee set too far anterior</li><li>• Heel bumper too firm in prosthetic foot</li><li>• Socket flexion does not match contracture</li><li>• Weak hip extensors</li></ul>
Unequal step length – short prosthetic step	<ul style="list-style-type: none"><li>• Improper prosthetic knee friction or extension</li><li>• Unstable prosthetic knee</li><li>• Muscle weakness, patient insecurity, gait training</li></ul>

# Loading Response



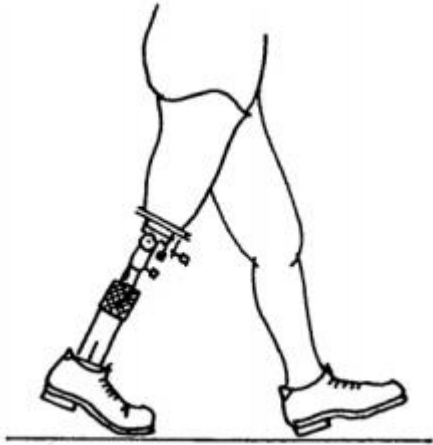
Deviation	Possible Cause
External foot rotation	<ul style="list-style-type: none"><li data-bbox="1280 521 1609 603">• Prosthetic foot bumper too firm</li><li data-bbox="1280 609 1609 647">• Loose socket fit</li><li data-bbox="1280 653 1682 691">• Poor muscle control</li></ul>

# Midstance



Deviation	Possible Cause
Abducted gait	<ul style="list-style-type: none"><li>• Pain or pressure on ramus or lateral distal femur</li><li>• Lateral wall of socket has space</li><li>• Prosthesis too long</li><li>• Patient weakness or contracture, lacks balance</li></ul>
Lateral trunk bending	<ul style="list-style-type: none"><li>• Prosthesis too short</li><li>• Space within socket</li><li>• Pain or pressure on ramus or lateral distal femur</li><li>• Short residual limb</li><li>• Patient has weak or contracted hip abductors</li></ul>

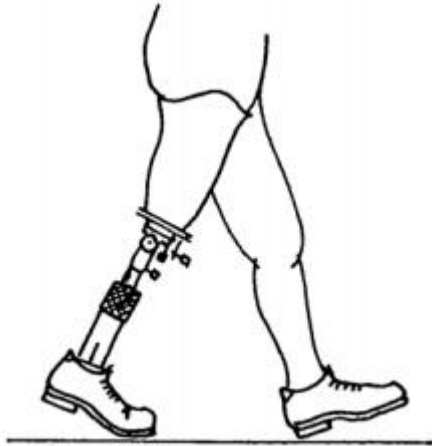
# Terminal Swing



<b>Deviation</b>	<b>Possible Cause</b>
Pelvic rise	<ul style="list-style-type: none"><li>• Toe lever too long</li></ul>
Drop off	<ul style="list-style-type: none"><li>• Toe lever too short</li></ul>

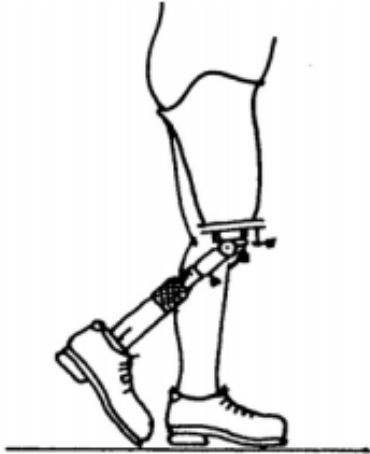


# Pre-Swing



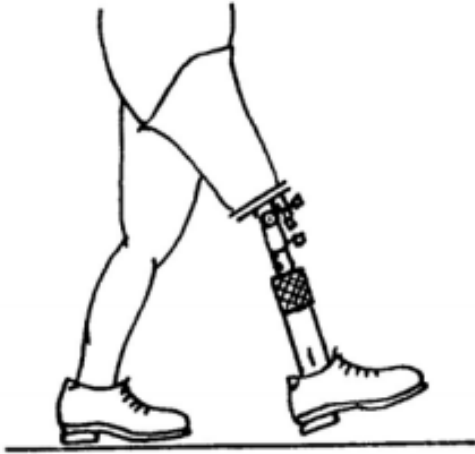
Deviation	Possible Cause
Medial Whip	<ul style="list-style-type: none"><li>• Prosthetic knee is external rotated</li><li>• Socket donned externally rotated</li></ul>
Lateral Whip	<ul style="list-style-type: none"><li>• Prosthetic knee is internally rotated</li><li>• Socket donned with internal rotation</li></ul>
Delayed knee flexion	<ul style="list-style-type: none"><li>• Prosthetic knee alignment too stable</li><li>• Prosthetic knee mechanical functions too stable</li></ul>
Uneven heel rise	<ul style="list-style-type: none"><li>• Prosthetic knee mechanical functions adjustments</li></ul>

# Initial and Midswing



Deviation	Possible Cause
Circumduction	<ul style="list-style-type: none"><li>• Excessive mechanical resistance to knee flexion</li><li>• Prosthesis too stable</li><li>• Prosthesis too long</li><li>• Inadequate hip flexion</li></ul>
Vaulting	<ul style="list-style-type: none"><li>• Excessive mechanical resistance to knee flexion</li><li>• Prosthesis too stable</li><li>• Prosthesis too long</li><li>• Patient habit</li></ul>

# Terminal Swing



Deviation	Possible Cause
Excessive terminal impact	<ul style="list-style-type: none"><li>• Patient habit to know knee extended</li><li>• Mechanical functions of prosthetic knee</li></ul>
Unequal step length – long prosthetic step, short sound side step	<ul style="list-style-type: none"><li>• Hip contracture not accommodated for in socket</li></ul>

# Mechanical Functions of Prosthetic Knees

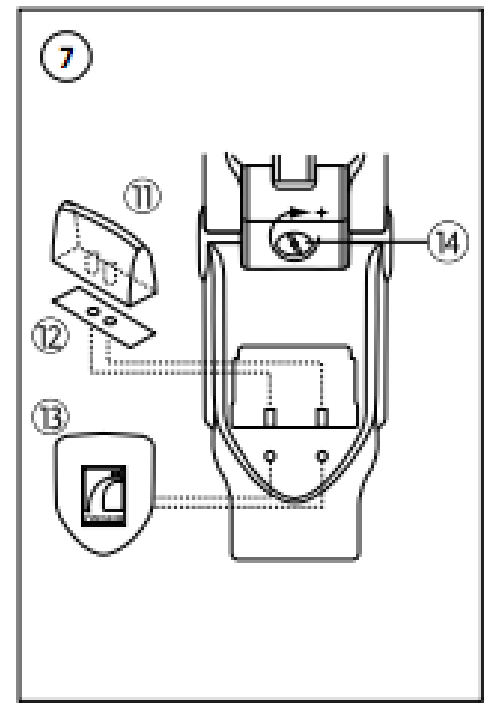
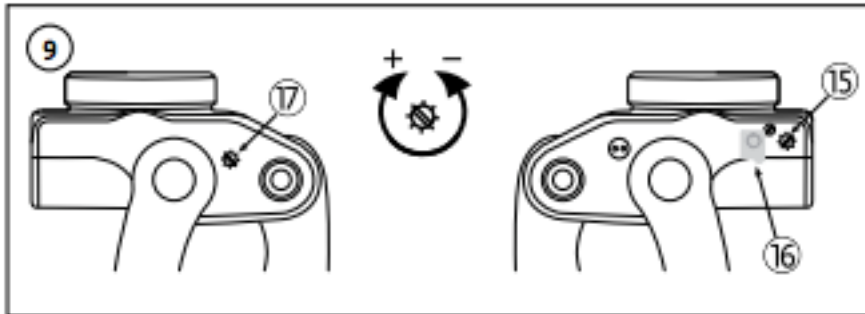
## i.e. Total Knee

**Stance Flexion** – Amount prosthetic knee flexes at initial contact (11-13)

**Flexion Resistance** – Can control prosthetic knee stability and heel rise (15&16)

**Extension Resistance** – Controls knee from heel rise through terminal swing (17)


**Extension Assist** – Promotes knee extension from heel rise to terminal swing (14)



# Microprocessor Knee Control

Calibration   Loading   Auto Adjustment   **Manual Adjustments**   Activity Report


### Stance Flexion



Level Ground  50

Stars and Ramps  50


### Swing Extension



Level Ground  20


Stars and Ramps  0

### Stance Extension



30


### Terminal Swing



Terminal Swing Resistance  20


Terminal Swing Point  20

### Flexion Target Angle



1  2 3 60

### Extension Hold



4  Extension Hold

# Transfemoral Gait Videos

The background features abstract, overlapping geometric shapes in shades of red and blue. A large, semi-transparent red shape is positioned in the upper right, while various shades of blue shapes are layered beneath and around it, creating a dynamic, modern aesthetic.

## 7. What is the deviation?



## 8. What is the deviation?





## 9. What is the deviation?



# What is the deviation?



# Impact of Technology

