

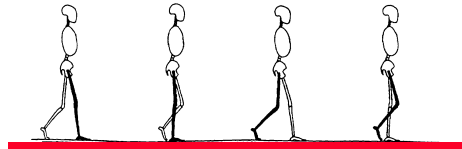
## Sagittal Plane Kinematics & Kinetics of Normal and Amputee Gait

John W. Michael, MEd, CPO, FISPO, FAAOP

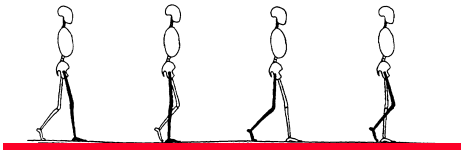
President, CPO Services, Inc.

JWM@CPOServices.com

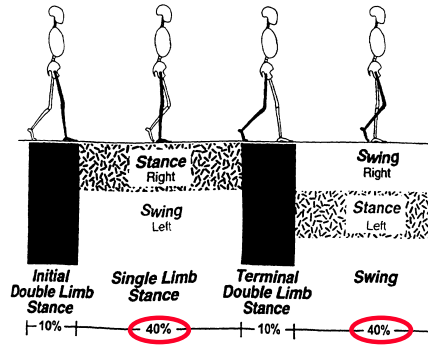
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**Normal Human Locomotion:  
Sagittal Plane Gait Kinematics**



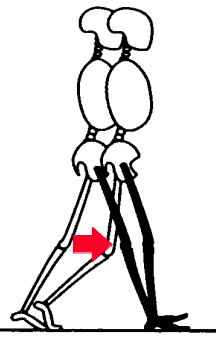
- 1) Stance Stability -vs- Ease of Swing
- 2) Is normal motion possible?
- 3) Is gait smooth & confident?



Initial Contact

### Initial Contact:

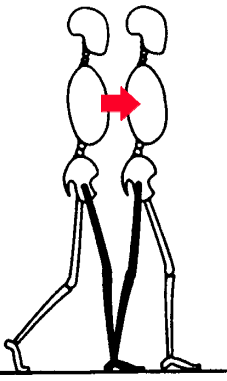
- Double Support
- Hip = Flexed
- Knee = Extended
- Ankle = Neutral
- Goal = Begin Stance



Loading Response

### Loading Response:

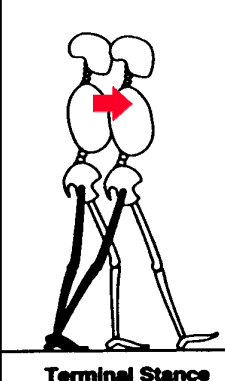
- Double Support
- Hip = Flexed
- Knee = Flexing
- Ankle = Plantarflexing
- Goals = Weight Acceptance, Shock Absorption, Advance body over Heel Rocker



**Mid Stance:**

- Single Support
- Hip = Extending
- Knee = Extending
- Ankle = Dorsiflexing
- Goal = Advance body over stationary foot via second rocker

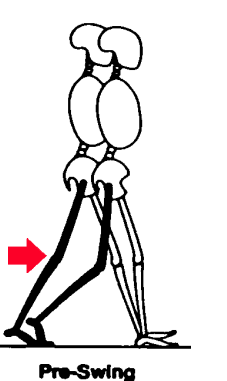
Mid Stance



**Terminal Stance:**

- Single Support
- Hip = Extending
- Knee = Extend, then Flex
- Ankle = Neutral
- Goal = Advance body over forefoot via third rocker

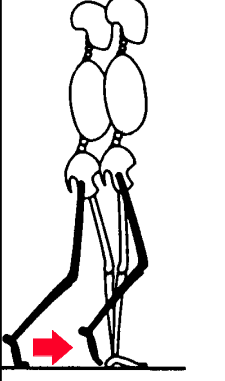
Terminal Stance



**Pre Swing:**

- Double Support
- Hip = Flexing
- Knee = Flexing
- Ankle = Plantarflexing
- Goal = Prepare for Swing

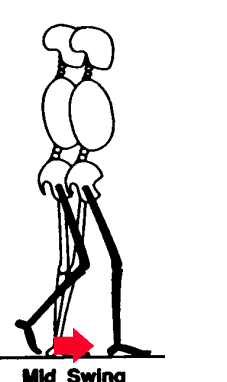
Pre-Swing



**Initial Swing:**

- Single Support
- Hip = Flexing
- Knee = Flexing
- Ankle = Dorsiflexing
- Goal = Clear foot and advance limb

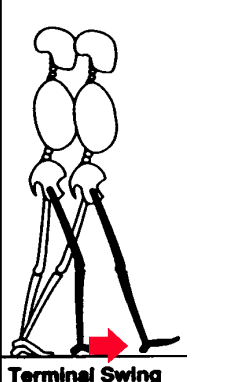
Initial Swing



**Mid Swing:**

- Single Support
- Hip = Flexing
- Knee = Extending
- Ankle = Dorsiflexing
- Goal = Advance limb and clear foot

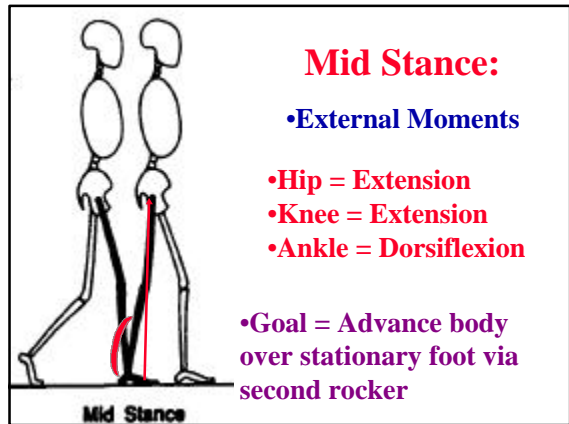
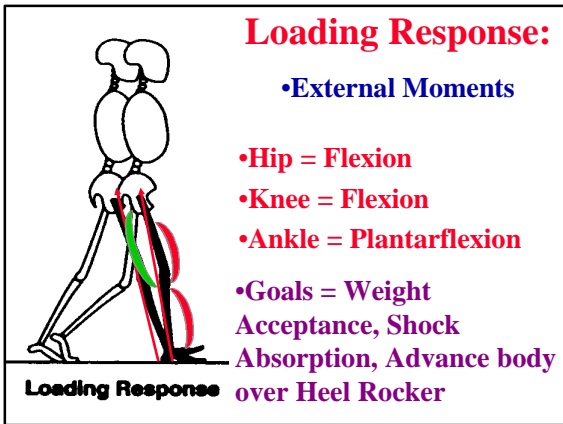
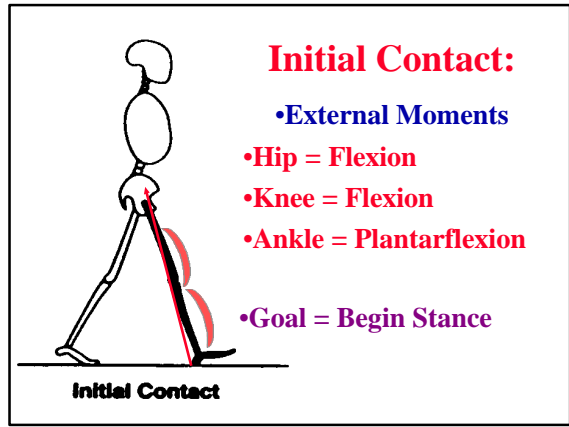
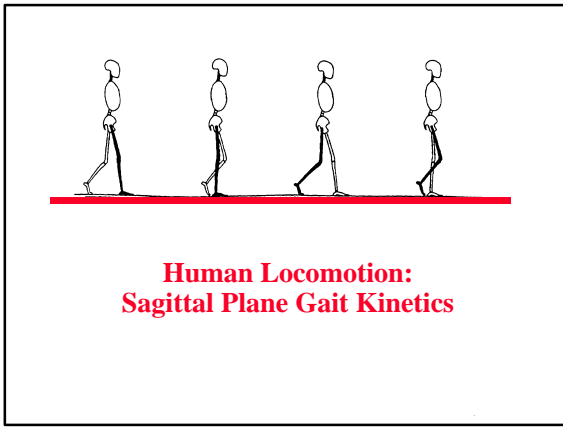
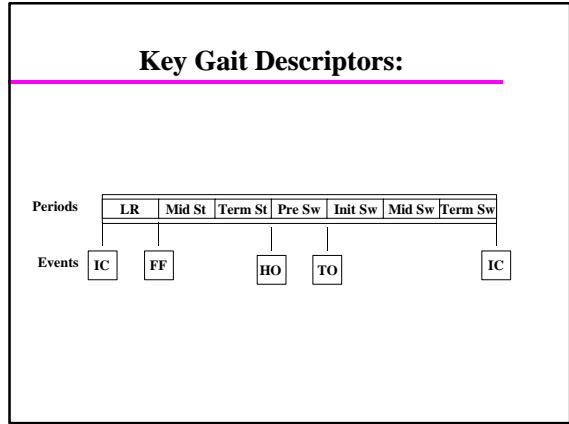
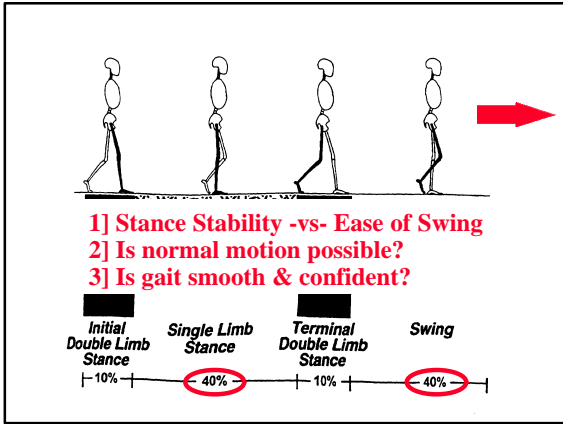
Mid Swing



**Terminal Swing:**

- Single Support
- Hip = Flexed
- Knee = Extending
- Ankle = Neutral
- Goal = Advance limb and prepare for next step

Terminal Swing



**Terminal Stance:**

- External Moments
- Hip = Extension
- Knee = Extension, then Flexion
- Ankle =Dorsiflexion
- Goal = Advance body over forefoot via third rocker

**Terminal Stance**

**Pre Swing:**

- External Moments
- Hip = Flexion
- Knee = Flexion
- Ankle = Dorsiflexion
- Goal = Prepare for Swing

**Pre-Swing**

**Initial Swing:**

- Joint Motion
- Hip = Flexing
- Knee = Flexing
- Ankle =Dorsiflexing
- Goal = Clear foot and advance limb

**Initial Swing**

**Mid Swing:**

- Joint Motion
- Hip = Flexing
- Knee = Extending
- Ankle =Dorsiflexing
- Goal = Advance limb and clear foot

**Mid Swing**

**Terminal Swing:**

- Joint Motion
- Hip = Stops Flexing
- Knee = Extends Fully
- Ankle = Remains Neutral
- Goal = Advance limb and prepare for next step

**Terminal Swing**

**Initial Contact:**

- External Moments
- Hip = Flexion
- Knee = Flexion
- Ankle = Plantarflexion
- Goal = Begin Stance

**Initial Contact**