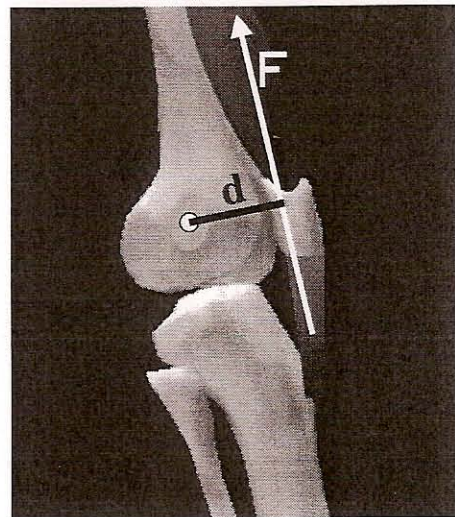
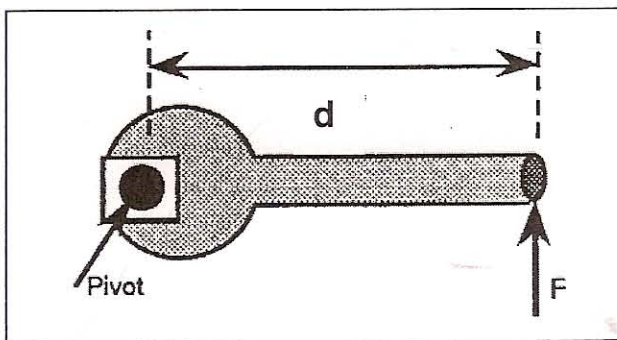


1. KINETIC FUNDAMENTALS

A. Moments

- A moment is a force's ability to cause the rotation of an object
- Synonymous with torque
- $\text{Moment} = \text{force} \times \text{distance}$

Examples:

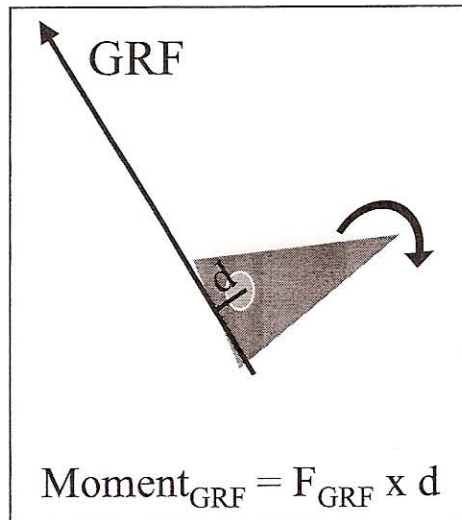
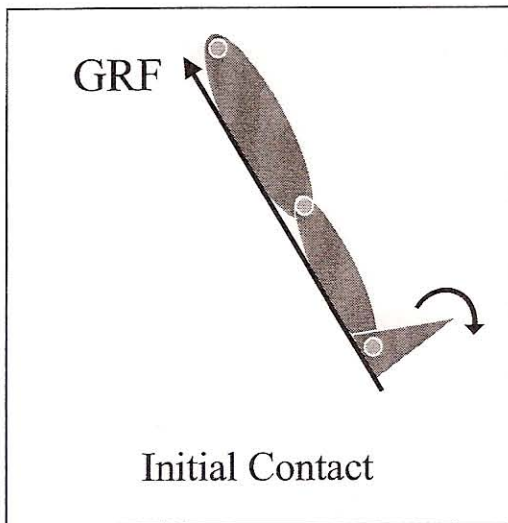


Net Moments

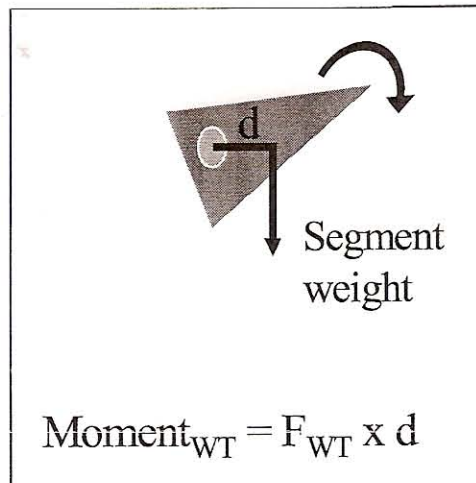
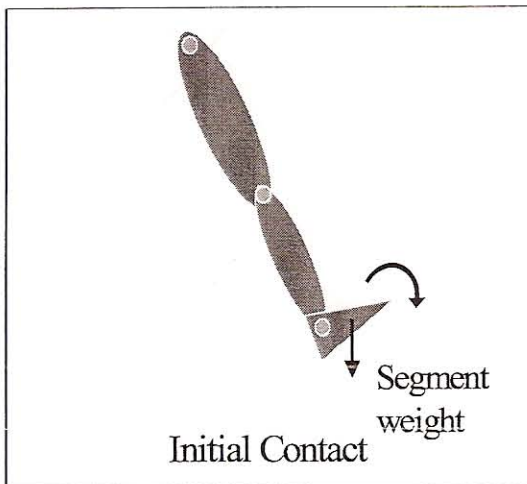
- External Forces
 - Ground reaction force
 - Gravity – weight of the segment
 - Inertia – segments rotational inertia
- Internal Forces
 - Muscles
 - Passive tissues which provided constraining forces – joint capsules, ligaments etc

Examples of some of the moments occurring at the ankle at initial contact

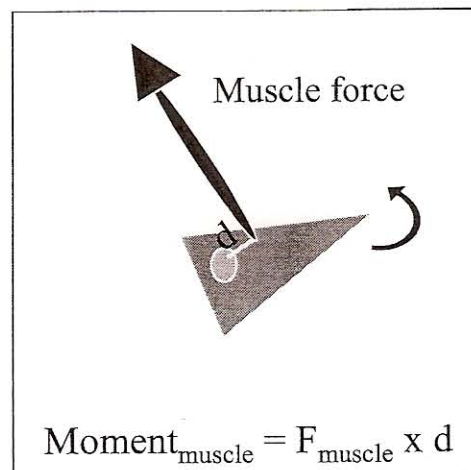
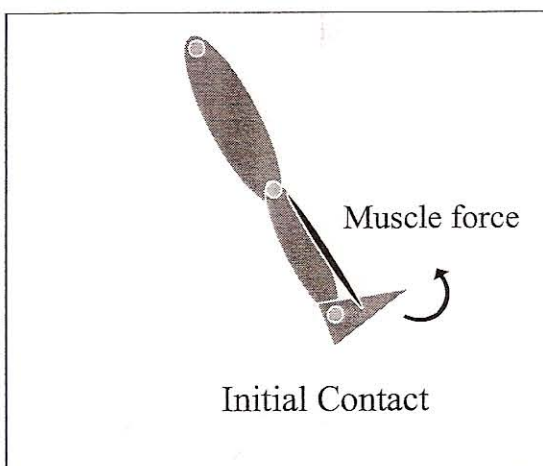
1. Ground reaction force generates a plantar flexor moment



2. Segment weight generates a plantar flexor moment



3. Ankle dorsiflexor muscles generate at dorsiflexor moment



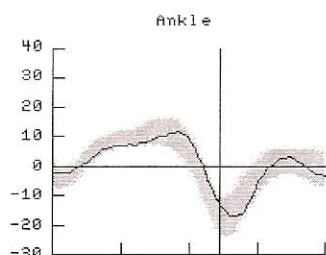
Net Internal Moment

- Net Internal Moment = Body's response to external moments (ground reaction force, segment's rotational inertia and gravity) in order to provide the desired motion (stability, acceleration, deceleration)
- Calculated through a process called inverse dynamics

B. Power

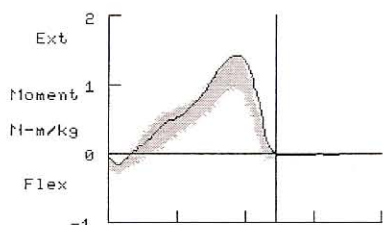
$$\text{Power} = \text{Moment} \times \text{Angular Velocity}$$

Motion



1. Determine angular velocity by looking at the slope of the motion curve

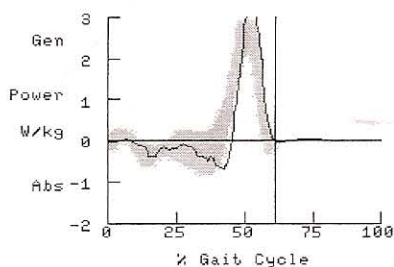
Moment



2. Assess the amplitude of the moment

amplitude du mouvement

Power



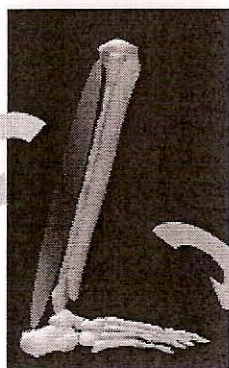
3. Calculate the power

force

Power Generation and Absorption

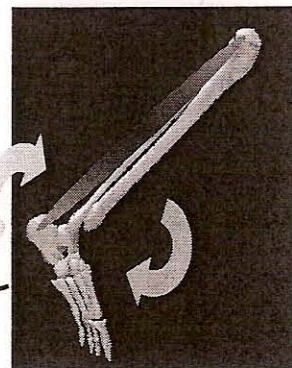
- Absorption is usually associated with an eccentric contraction
- Generation is usually associated with a concentric contraction

Power Absorption

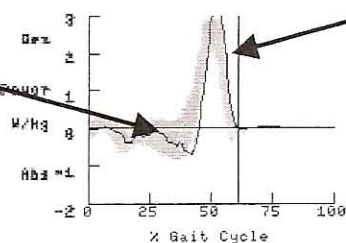


Second rocker

Power Generation



Third Rocker



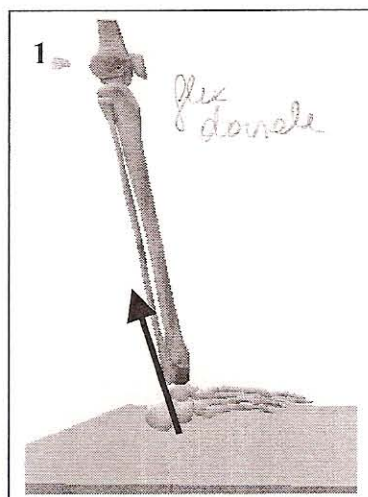
8 5 utilise lors description de la marche

Normal Kinetic Patterns

ANKLE

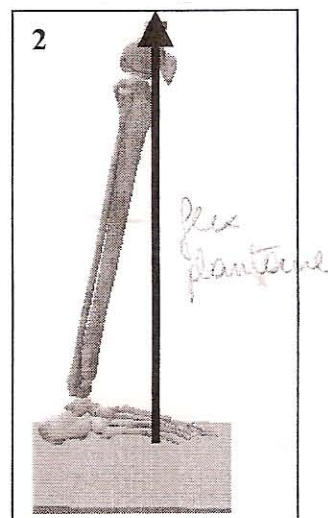
1. First Rocker

- Heel initial contact
- Small dorsiflexor moment to prevent foot slap
- Negligible power



2. Second Rocker

- Weightbearing progresses distally on the foot
- Eccentric ankle plantar flexor activity allows for controlled ankle dorsiflexion
- Progressively larger ankle plantar flexor moment
- Negligible power



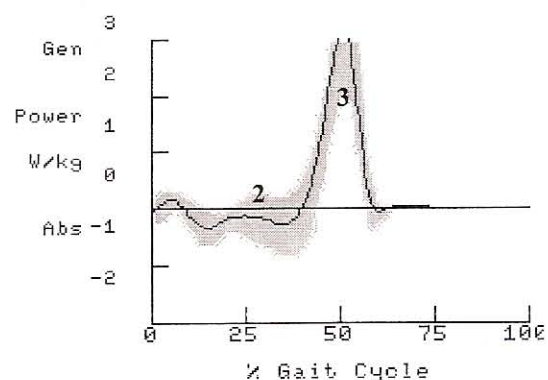
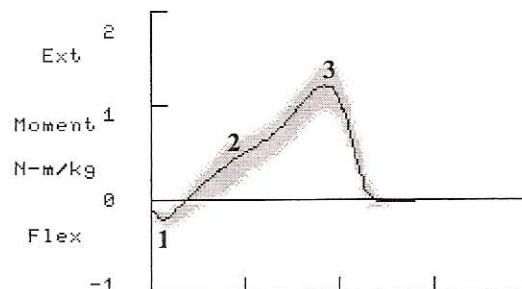
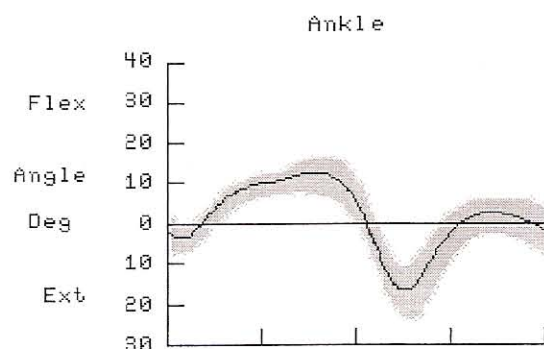
3. Third rocker

- Ankle plantar flexors concentrically contract to provide propulsion
- Large extensor moment and power generation until the end of single stance



4. Swing

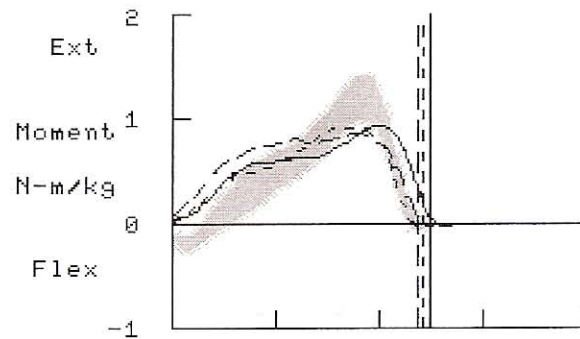
- Negligible moment and power secondary to small mass of the foot



Examples of Atypical Ankle Moments

Query 1: what abnormal foot contact pattern does this suggest?

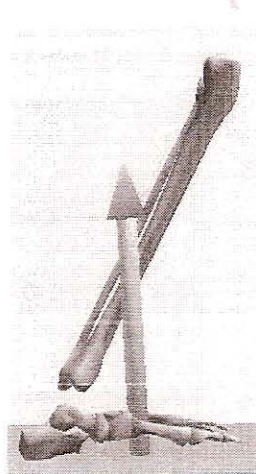
Sagittal plane ankle moment (3 trials vs. typical)



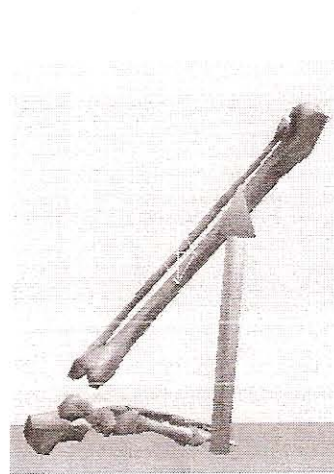
Loading Response



Mid Stance



Terminal Stance

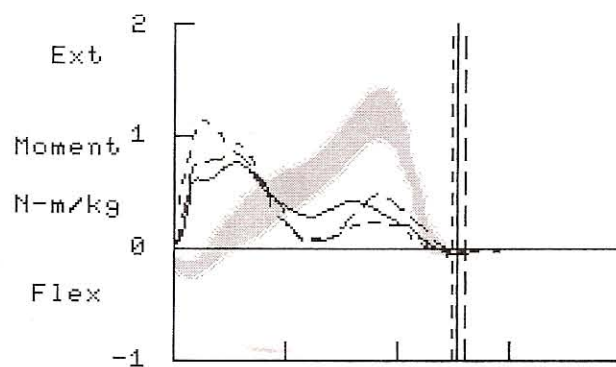


Answer 1: Foot flat initial contact pattern

- Absence of dorsiflexor moment during loading response
- Early and gradual development of a plantar flexor moment
- Normal peak plantar flexor moment in terminal stance

Query 2 : What abnormal contact pattern does this suggest?

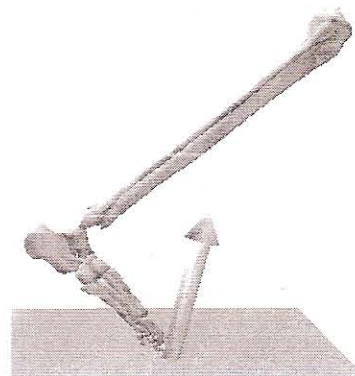
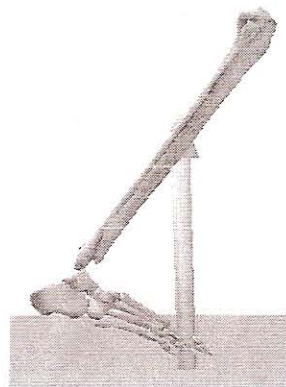
Sagittal plane ankle moment (3 trials vs. typical)



Loading Response

Mid Stance

Terminal Stance

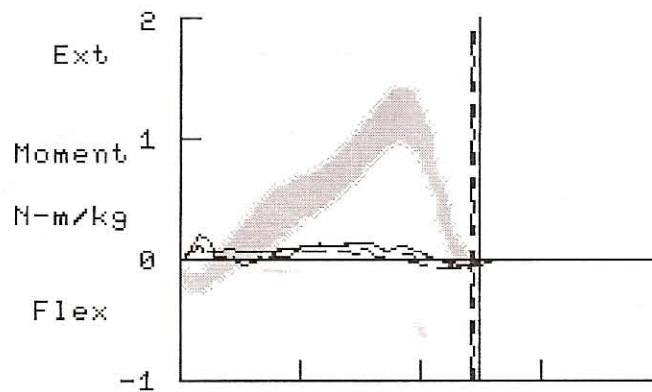


Answer 2: Toe initial contact pattern

- Absence of dorsiflexor moment during loading response
- Rapid development of a plantar flexor moment
- Reduced peak plantar flexor moment in terminal stance

Query 3: What abnormal contact pattern does this suggest?

Sagittal plane ankle moment (3 trials vs. typical)



Answer 3: Heel only weight bearing pattern

- **Absence of dorsiflexor moment during loading response**
- **Negligible plantar flexor moment through out stance**

Normal Kinetic Patterns

1. Initial Contact

- GRF passes through or in front of the knee joint

2. Loading Response

- Knee flexes and GRF passes behind the knee
- Eccentric quadriceps activity provides a knee extensor moment and power absorption

3. Midstance to Terminal stance

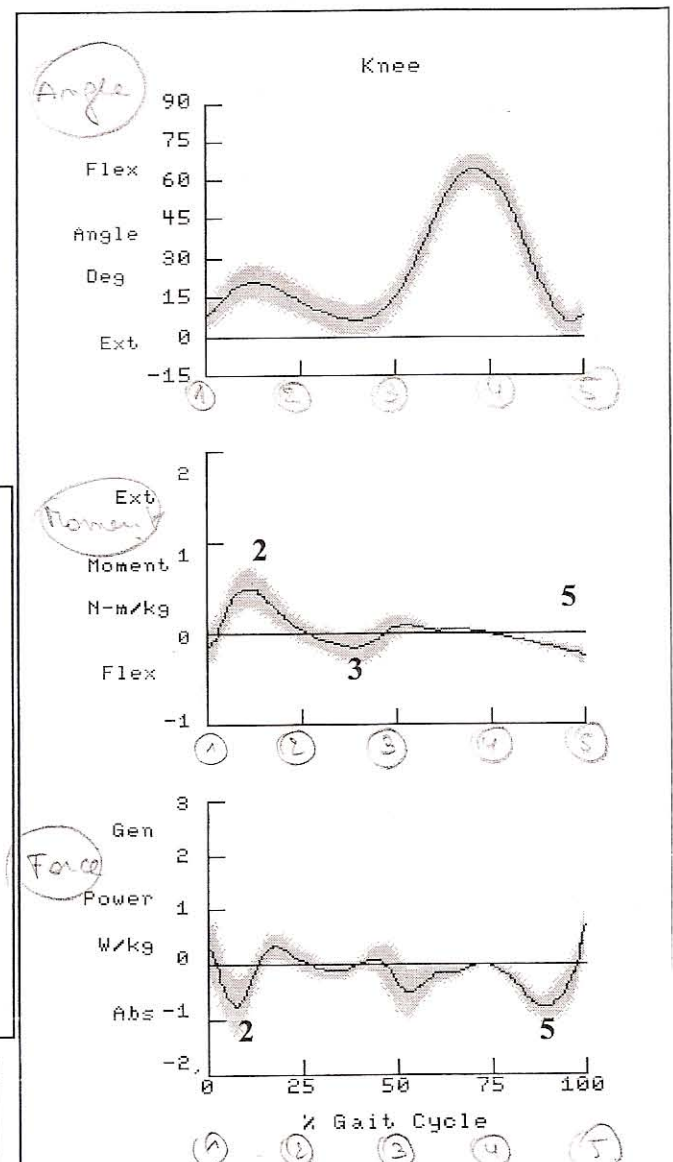
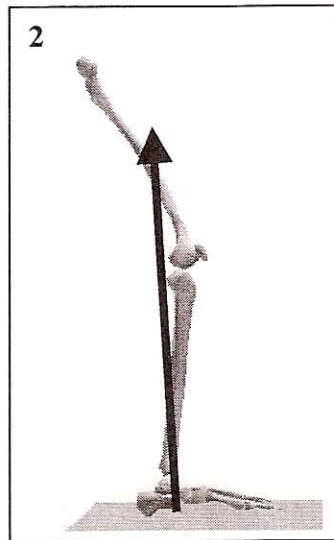
- Knee extends and GRF passes slightly in front of the knee joint
- small flexor moment is provided by passive stretch of posterior soft tissues (i.e. joint capsule)
- negligible power

4. Preswing

- Rapid flexion of the knee along with unweighting of the lower extremity
- GRF passes behind the knee assisting with knee flexion

5. Swing

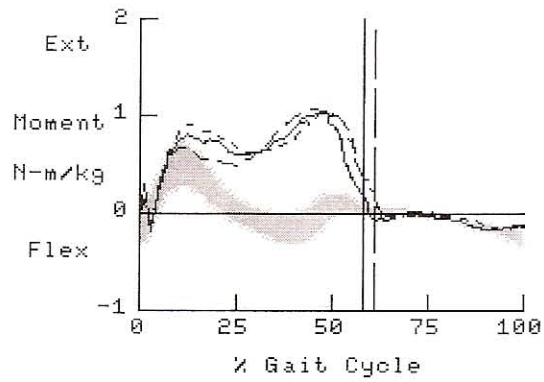
- Progressive flexor moment and power absorption as knee is decelerated by eccentric hamstring activity



Examples of atypical knee moments

Query 4: What knee motion does this knee moment suggest?

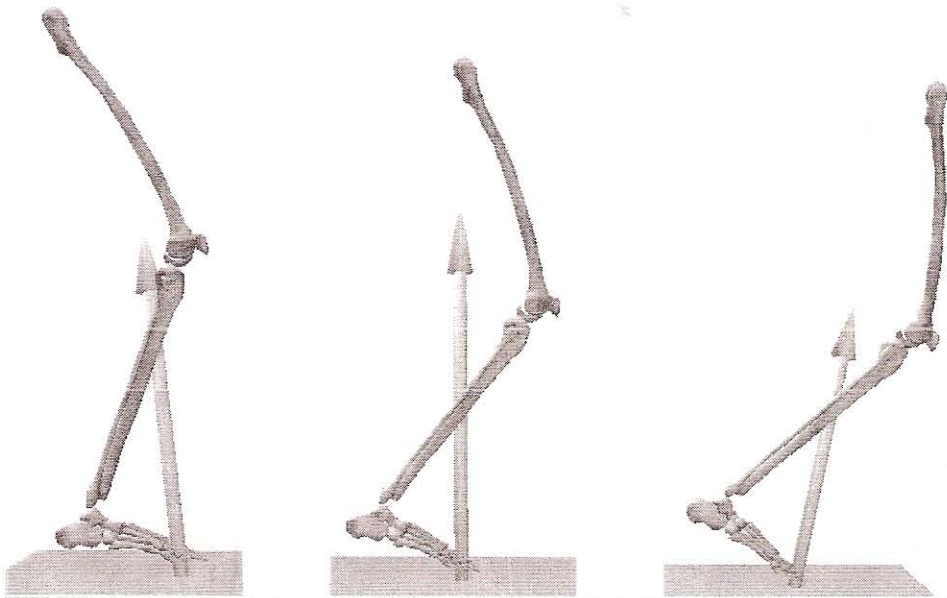
Sagittal plane knee moment (3 trials vs. typical)



Loading Response

Mid Stance

Terminal Stance

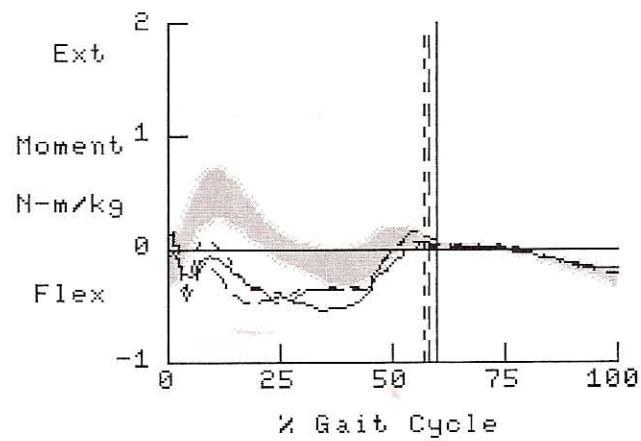


Answer 4: Severe knee flexion gait

- Knee flexion through out stance
- Knee extensor moment through out stance

Query 5: What knee motion does this knee moment suggest?

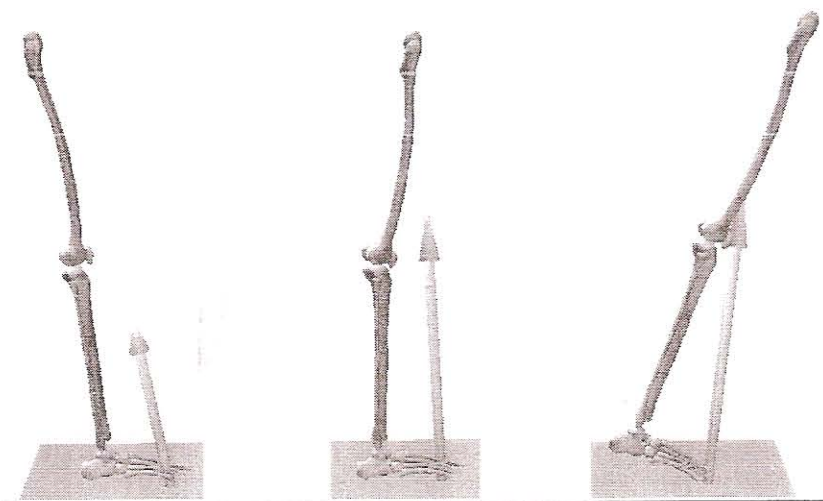
Sagittal plane knee moment (3 trials vs. typical)



Loading Response

Mid Stance

Terminal Stance



Answer 5: Knee extension gait

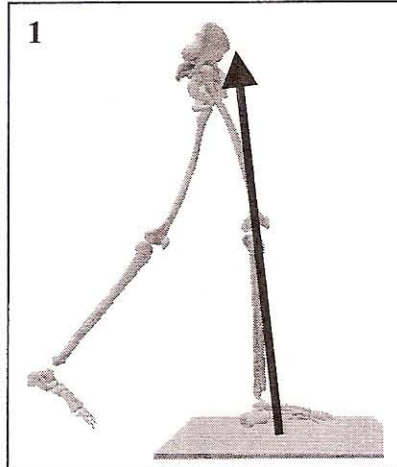
- **Knee hyper extension or rapid knee extension at initial contact**
- **Knee flexor moment through out stance**

Normal Kinetic Patterns

HIP

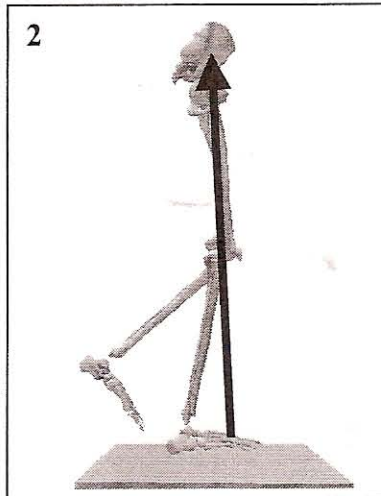
1. Initial Contact to Loading response

- GRF passes in front of the hip
- Concentric gluteal activity provides hip extension, a hip extensor moment and power generation



2. Midstance

- GRF passes through the hip resulting in a zero moment and power



3. Terminal Stance

- GRF passes behind the hip
- Passive stretch of anterior soft tissues provide a flexor moment and power absorption

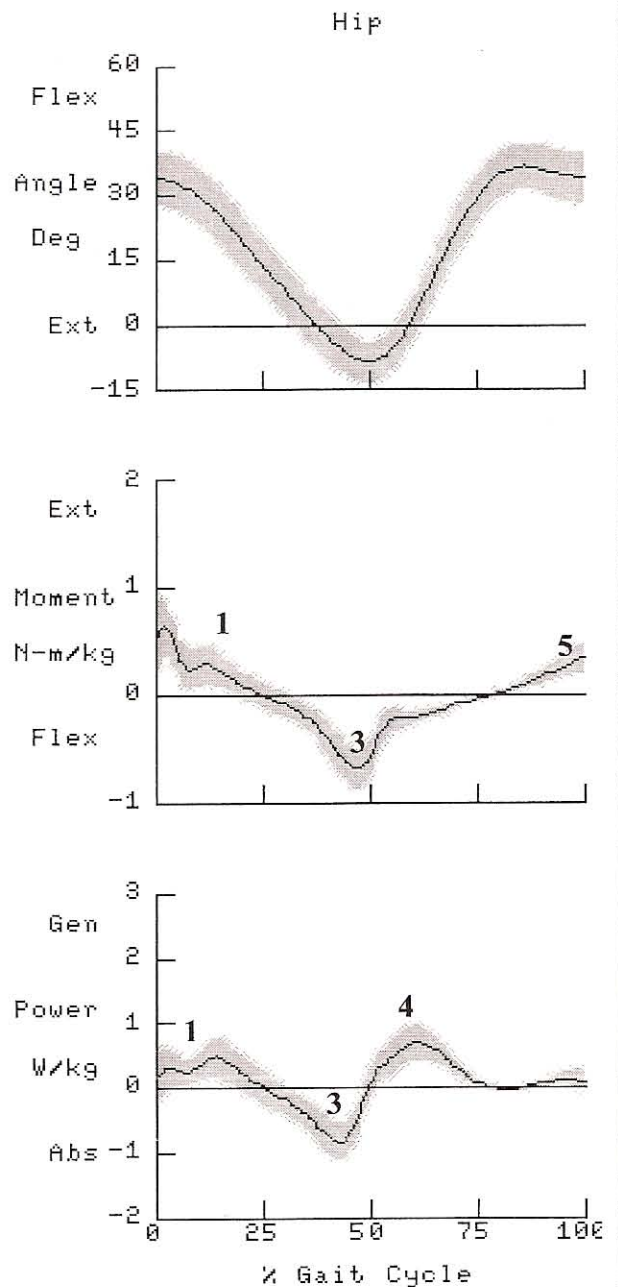


4. Preswing to Initial Swing

- Hip flexor activity initiates rapid hip flexion and provides power generation

5. Mid to Terminal Swing

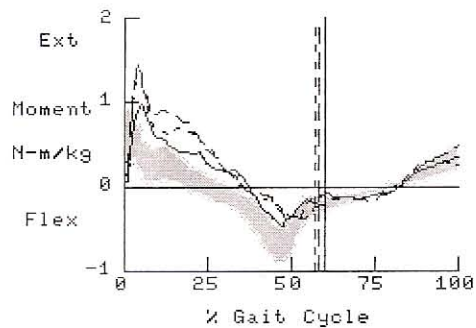
- Progressive extensor moment provided by hamstrings to decelerate the thigh



Example of an Atypical Hip Moment

Query 6: What abnormal motion does this hip moment suggest?

Sagittal plane hip moment (3 trials vs. typical)



Loading Response

Mid Stance

Terminal Stance



Answer 6: Hip flexion gait

- Hip motion skewed towards flexion (secondary to crouch)
- Increased and prolonged hip extensor moment in stance