SCOREBUILDERS

SPOTLIGHT *Series*

Gait Is Dynamic: Ways to Break it Down and Make it Fun!

Presented by Holly Daniel, PT

Objectives

- Define and discuss the components of the gait cycle
- Identify and describe muscle activation at the ankle, knee, and hip during each phase of the gait cycle
- Identify range of motion requirements at the ankle, knee, and hip for each phase of the gait cycle
- Discuss the relationship of impairments to common gait deviations

Habit 5: “Seek First to Understand”

- The 7 Habits of Highly Effective People
- First published in 1989
- Written by Stephen Covey
- New York Times Bestseller for 5 years during 1990s

Friedrich Nietzsche

“All truly great thoughts are conceived by walking.”

Gait Terminology (Standard/Ranchos)

Stance phase (60%):

- Heel strike (initial contact)
- Foot flat (loading response)
- Midstance
- Heel off (terminal stance)
- Toe off (preswing)

Swing phase (40%):

- Acceleration (initial swing)
- Midswing
- Deceleration (terminal swing)

Muscle Activation (Ankle)

Heel strike (initial contact) to Foot flat (loading response):

What is the ankle doing?

Moving from neutral to plantar flexion (PF)

What muscle activation would allow for PF when gravity is helping?

Eccentric dorsiflexors (decelerating ankle into PF)

Moving from Heel strike (initial contact) to Foot flat (loading response)

Heel strike (initial contact)
(Ankle neutral = 0 degrees)

Foot flat (loading response)
(15 degrees of PF)

Muscle Activation (Ankle)

Foot flat (loading response) to Midstance:

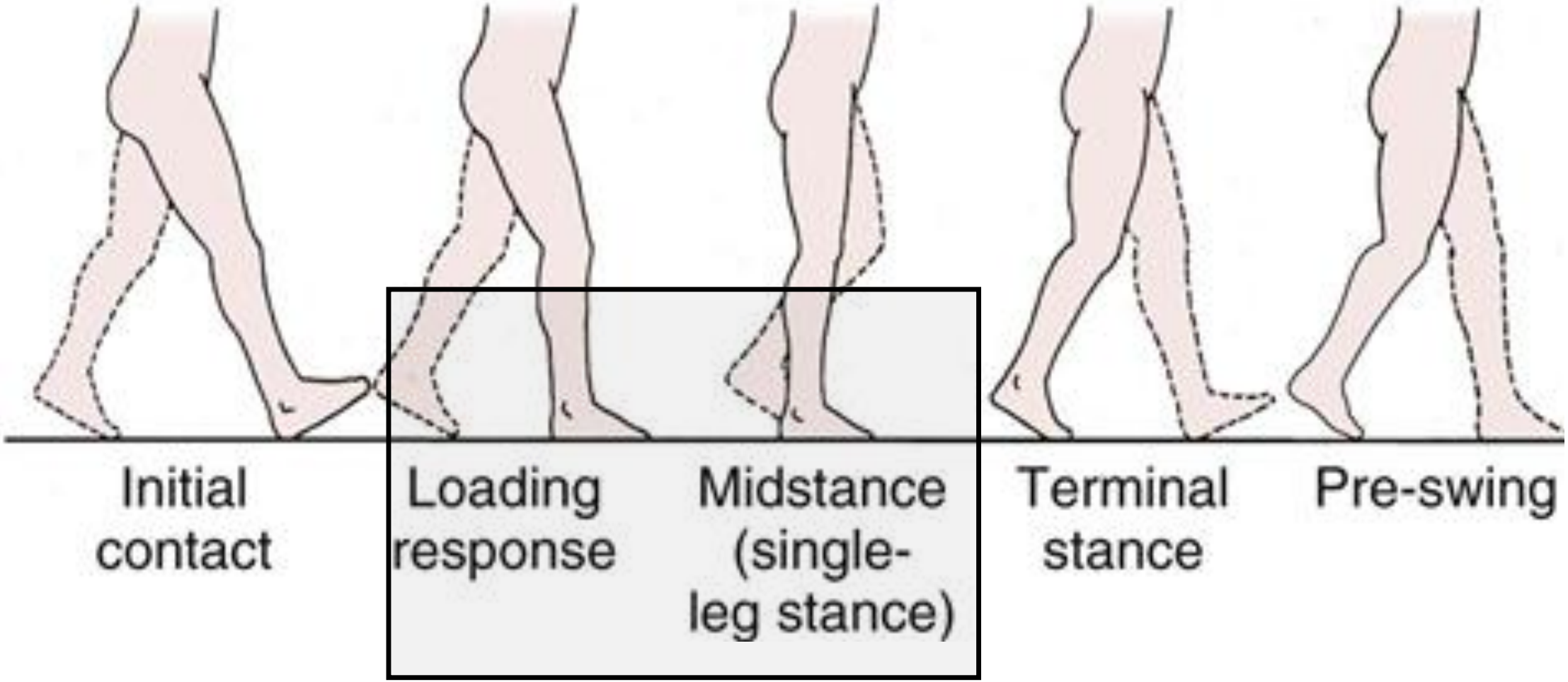
What is the ankle doing?

Moving from PF to 10 degrees dorsiflexion (DF)

What muscle activation would allow for DF when momentum is helping?

Eccentric plantar flexors (controlling DF as body moves over the stance leg)

Moving from Foot flat (loading response) to Midstance



Muscle Activation (Ankle)

Midstance to Heel off (terminal stance) and Toe off (preswing):

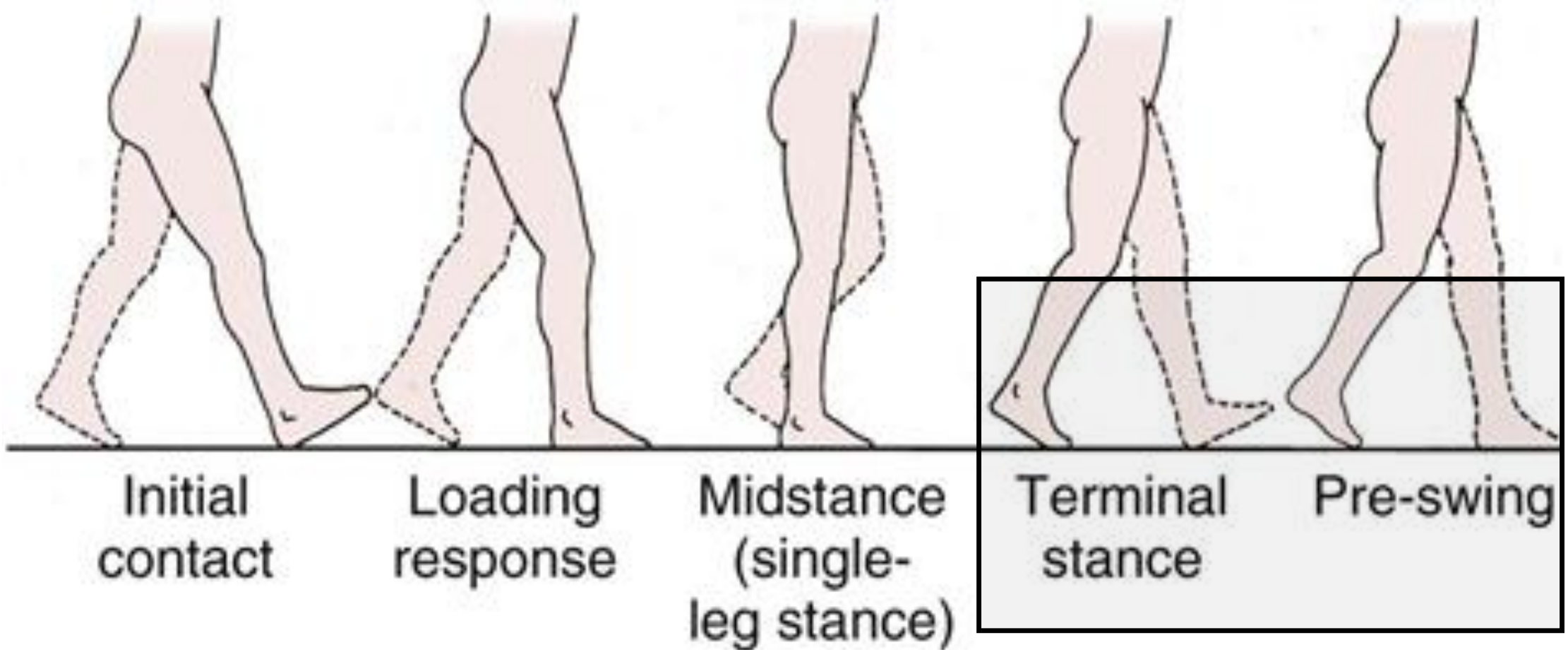
What is the ankle doing?

Moving back into PF (against gravity) to 20 degrees

What muscle activation would allow for PF when working against gravity?

Concentric plantar flexors (heel off and toe off are often referred together as “push-off” for a reason = propulsion!)

Moving from Midstance to Heel off (terminal stance) and Toe off (preswing)



Muscle Activation (Ankle)

Toe off (preswing) to Acceleration (initial swing):

What is the ankle doing?

Moving from PF back into DF to clear the foot

What muscle activation would allow for DF (against gravity)?

Concentric dorsiflexors to clear the foot from the ground during swing

Muscle Activation (Ankle)

Acceleration (initial swing) to Midswing:

What is the ankle doing?

Still moving into DF (against gravity)

What muscle activation would allow for DF (against gravity)?

Concentric dorsiflexors to maintain DF during swing

Muscle Activation (Ankle)

Midswing to Deceleration (terminal swing):

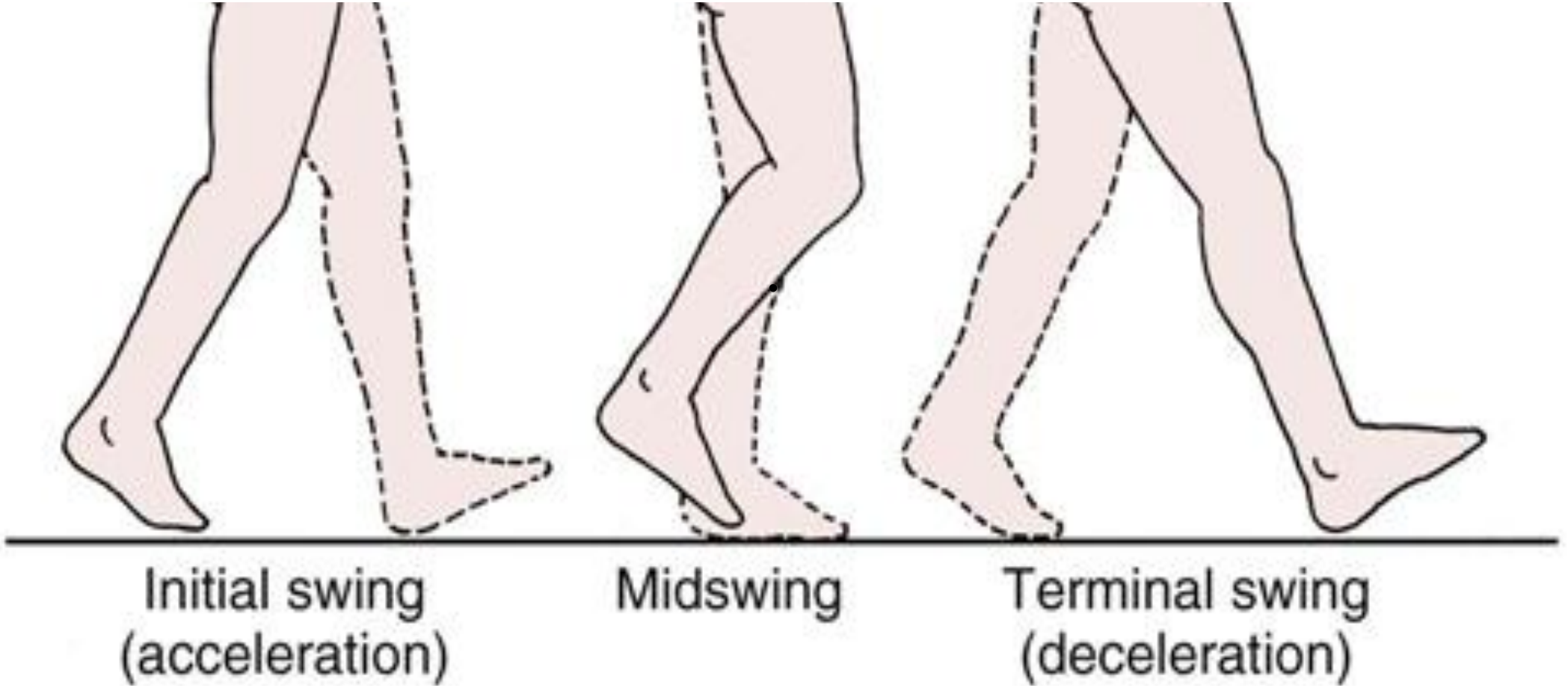
What is the ankle doing?

Maintaining DF to neutral

What muscle activation would maintain DF?

Concentric then isometric dorsiflexors to maintain DF during swing

Concentric Dorsiflexors Throughout Swing



So What If the Dorsiflexors Are Weak?

Common gait deviation in stance = Foot slap

Possible gait deviations in swing:

- Hip circumduction (substitute with hip abductors on swing limb)
- Hip hiking (substitute with quadratus lumborum on swing limb)
- Excessive hip/knee flexion = steppage gait (substitute with hip/knee flexors on swing limb)
- Vaulting on stance limb (substitute with concentric plantar flexors on stance limb, often combined with hip hiking on swing leg)

So What If the Plantar flexors Are Weak?

Common gait deviation in stance =
Lack of propulsion or “push off” during late (terminal) stance phase

Plantar flexors not active in swing!

Muscle Activation (Knee)

Heel strike (initial contact) to Foot flat (loading response):

What is the knee doing?

Moving from full extension to 15-20 degrees flexion as the limb accepts the weight of the body (loading response)

What muscle activation would allow for controlled knee flexion?

Eccentric quads to control the amount of knee flexion during loading

Moving from Heel strike (initial contact) to Foot flat (loading response)

Heel strike (initial contact)
(Knee in full extension = 0 degrees)

Foot flat (loading response)
(15-20 degrees of knee flexion)

Muscle Activation (Knee)

Foot flat (loading response) to Midstance:

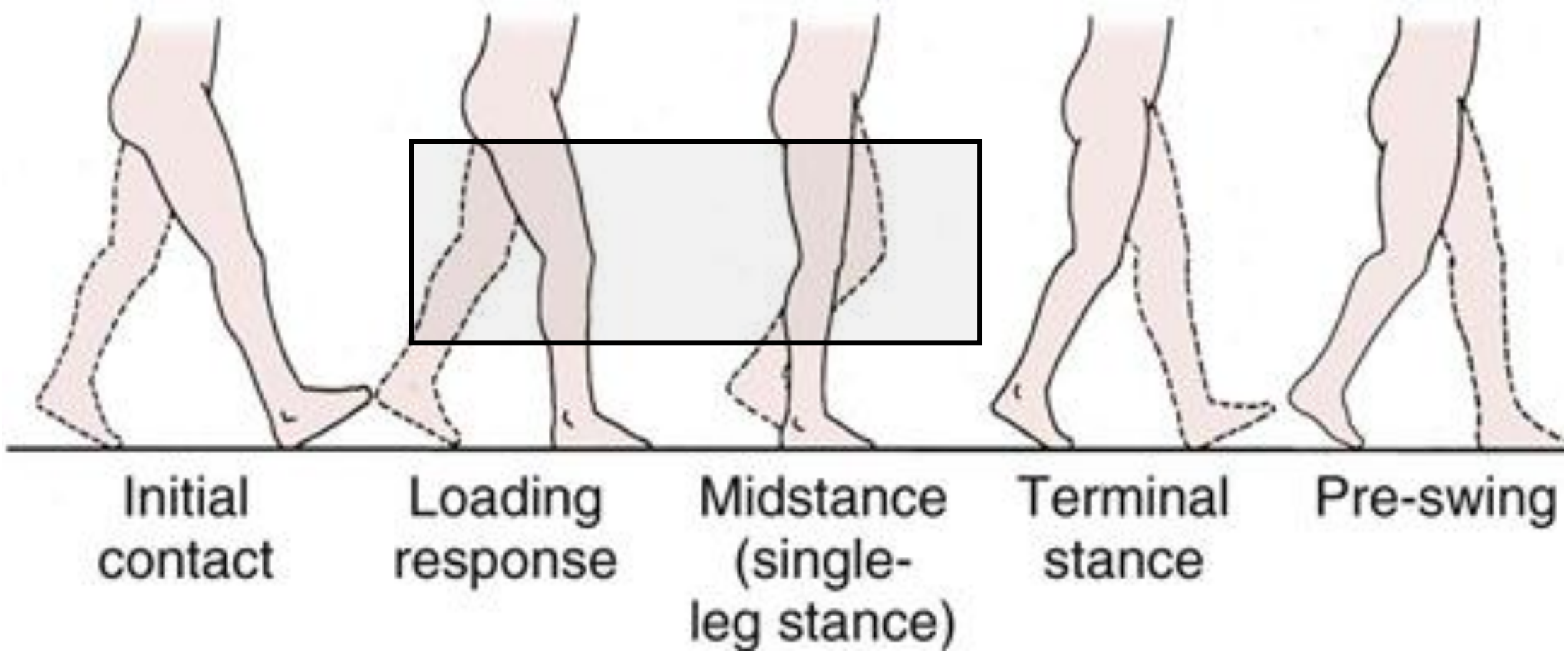
What is the knee doing?

Extending back to neutral

What muscle activation would allow for closed chain knee extension?

Concentric quads until neutral knee extension (then activity in the knee musculature is minimal during midstance)

Moving from Foot flat (loading response) to Midstance



Muscle Activation (Knee)

Midstance to Heel off (terminal stance) and Toe off (preswing):

What is the knee doing?

Knee muscle activity remains limited in late stance until the hamstrings begin to produce knee flexion at toe off (preswing) in preparation for the swing phase (momentum of body also aids in this motion)

Muscle Activation (Knee)

Acceleration (initial swing) to Midswing:

What is the knee doing?

Moving into about 60 degrees of knee flexion

What muscle activation would allow for knee flexion to shorten the swing leg?

Concentric hamstrings to bend the knee for foot clearance in early swing

Muscle Activation (Knee)

Midswing to Deceleration (terminal swing):

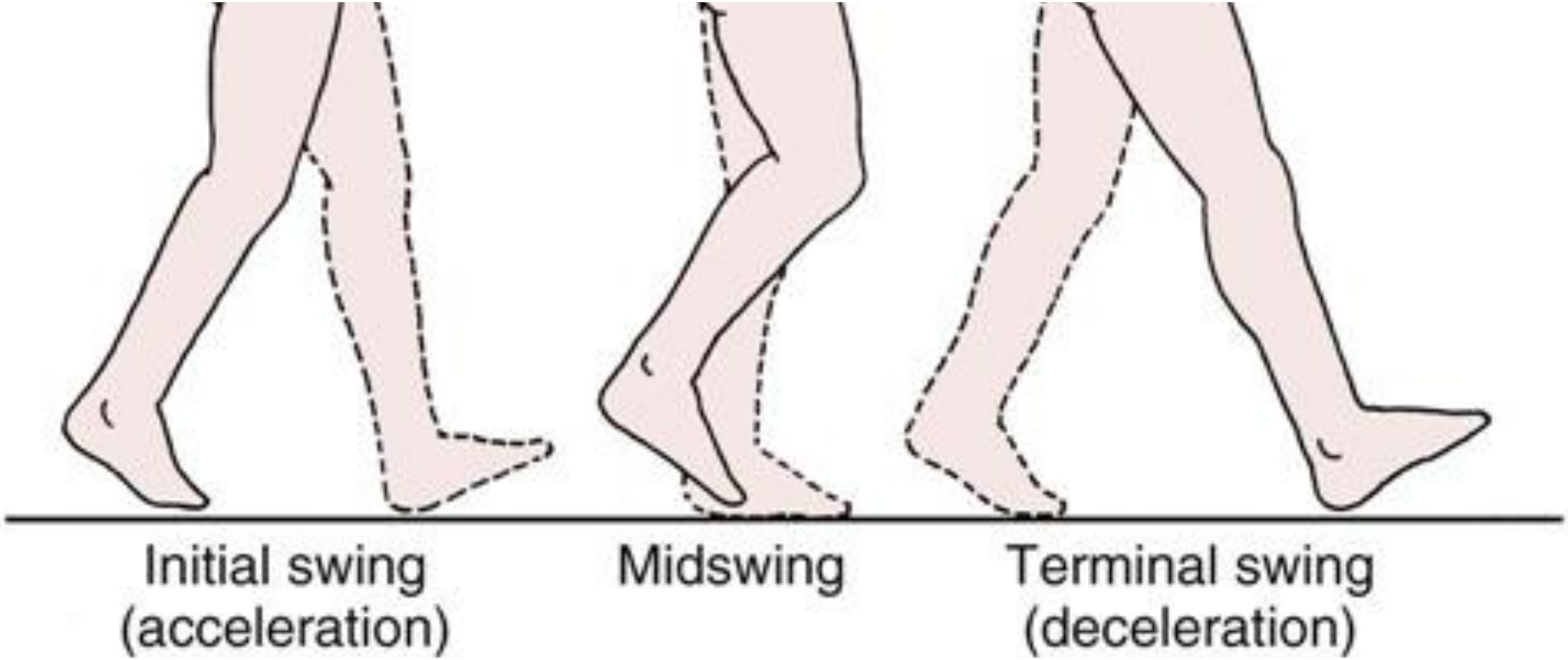
What is the knee doing?

Momentum of swing is moving the knee back into full extension

What muscle activation would control (decelerate) knee extension?

Eccentric hamstrings to slow the rate of knee extension during terminal swing

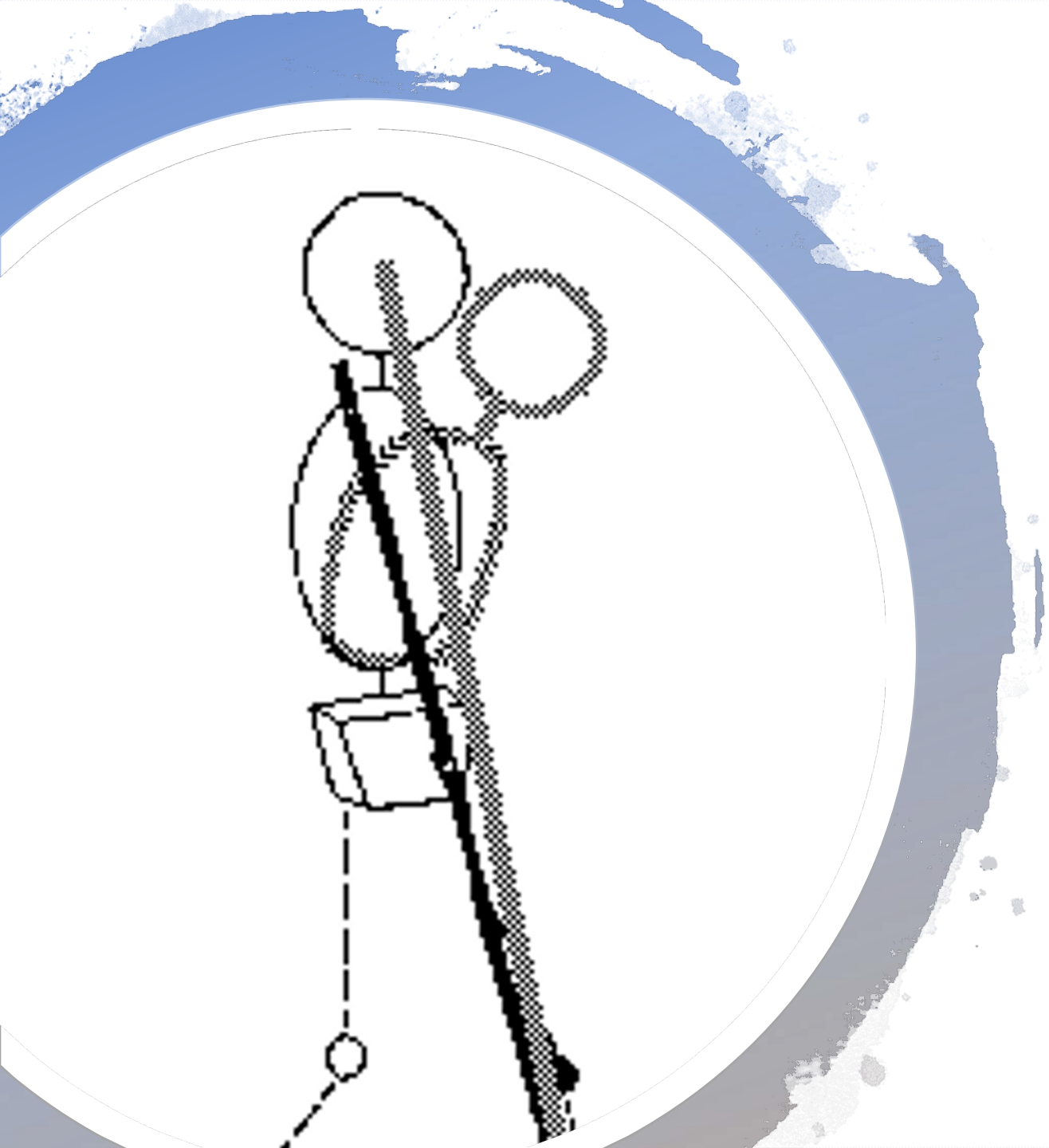
Knee Motion During Swing Phase



So What If the Quadriceps Are Weak?

Common gait deviation in stance =
Anterior trunk lean

- **Anterior trunk lean in early stance** (e.g., loading response) compensates for quadriceps weakness by moving the ground reaction force anterior to the knee to “lock” the knee in extension



Forward trunk lean during stance phase

So What If the Hamstrings Are Weak?

Common gait deviation in swing =
Poor deceleration in terminal swing

- Hamstrings eccentrically slow hip flexion and knee extension (deceleration) during terminal swing (before heel strike)

- Hamstrings mainly function during stance phase as a stabilizer for the knee (**quadriceps** more active in **stance** phase and **hamstrings** more active in **swing**)

Muscle Activation (Hip)

Heel strike (initial contact) to Foot flat (loading response):

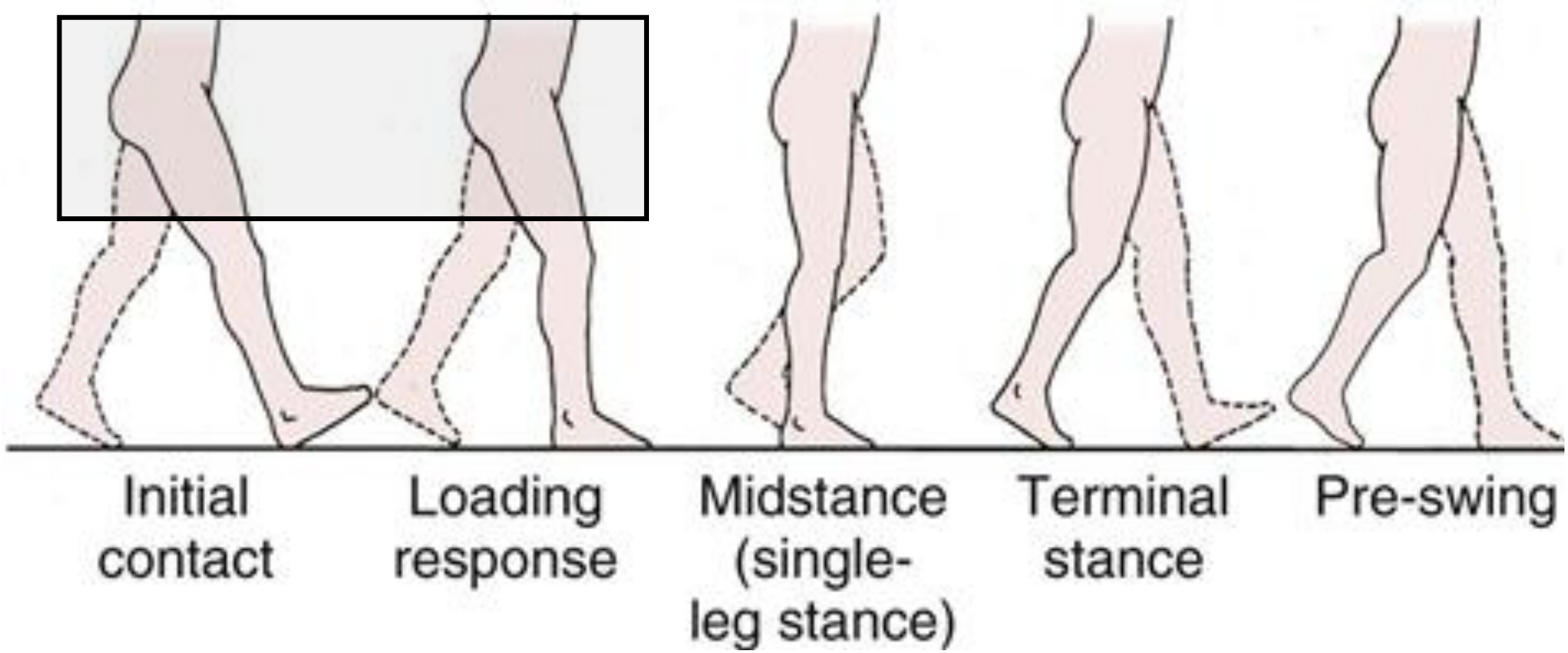
What is the hip doing?

Hip is in about 30 degrees flexion and stabilizing (in preparation for movement into extension)

What muscle activation would allow for a stable hip and pelvis? =

Isometric hip extensors (gluteus maximus) and hip abductors (gluteus medius & minimus)

Moving from Heel strike (initial contact) to Foot flat (loading response)



Muscle Activation (Hip)

Foot flat (loading response) to Midstance:

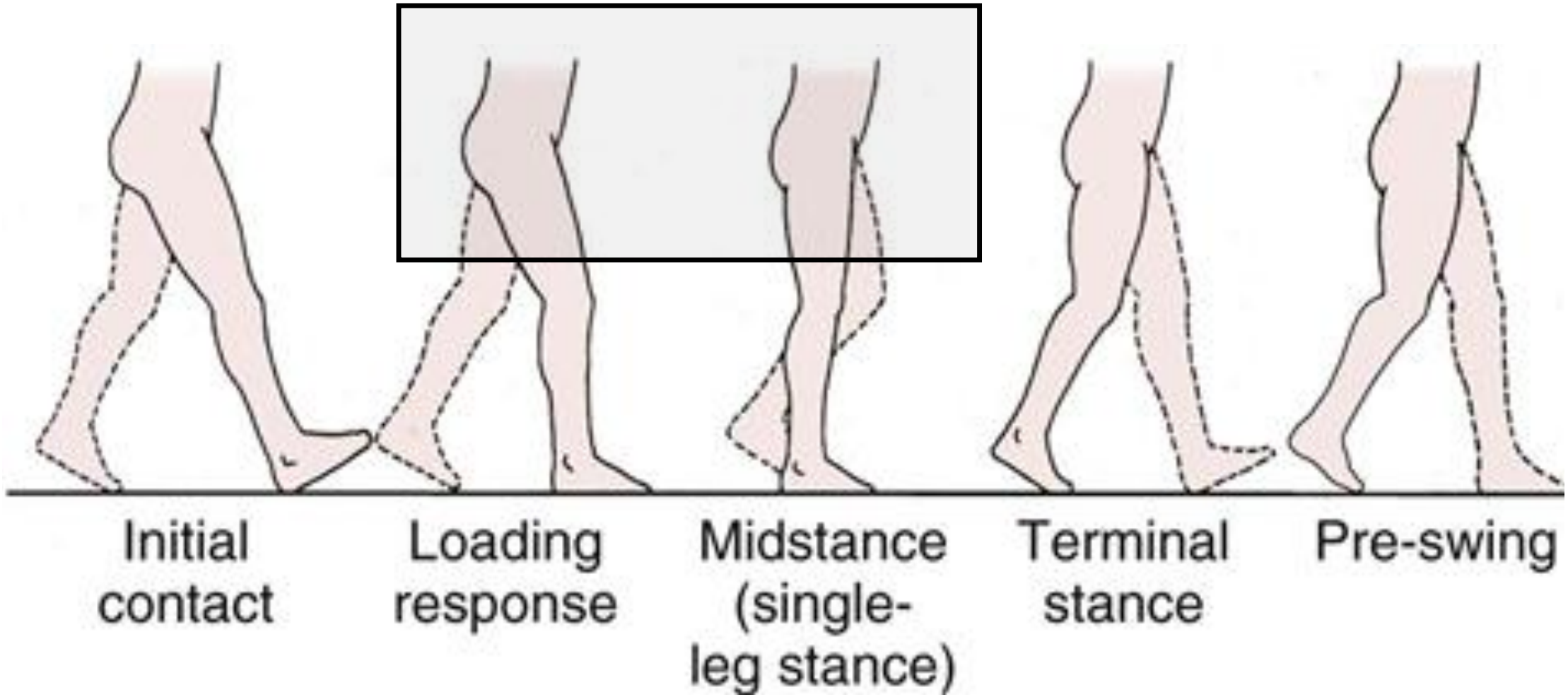
What is the hip doing?

Moving from 30 degrees flexion into extension (neutral)

What muscle activation would allow for closed chain hip extension?

Concentric hip extensors (gluteus maximus) to become more erect with hip abductors still stabilizing hip and pelvis

Moving from Foot flat (loading response) to Midstance



Muscle Activation (Hip)

Midstance to Heel off (terminal stance) and Toe off (preswing):

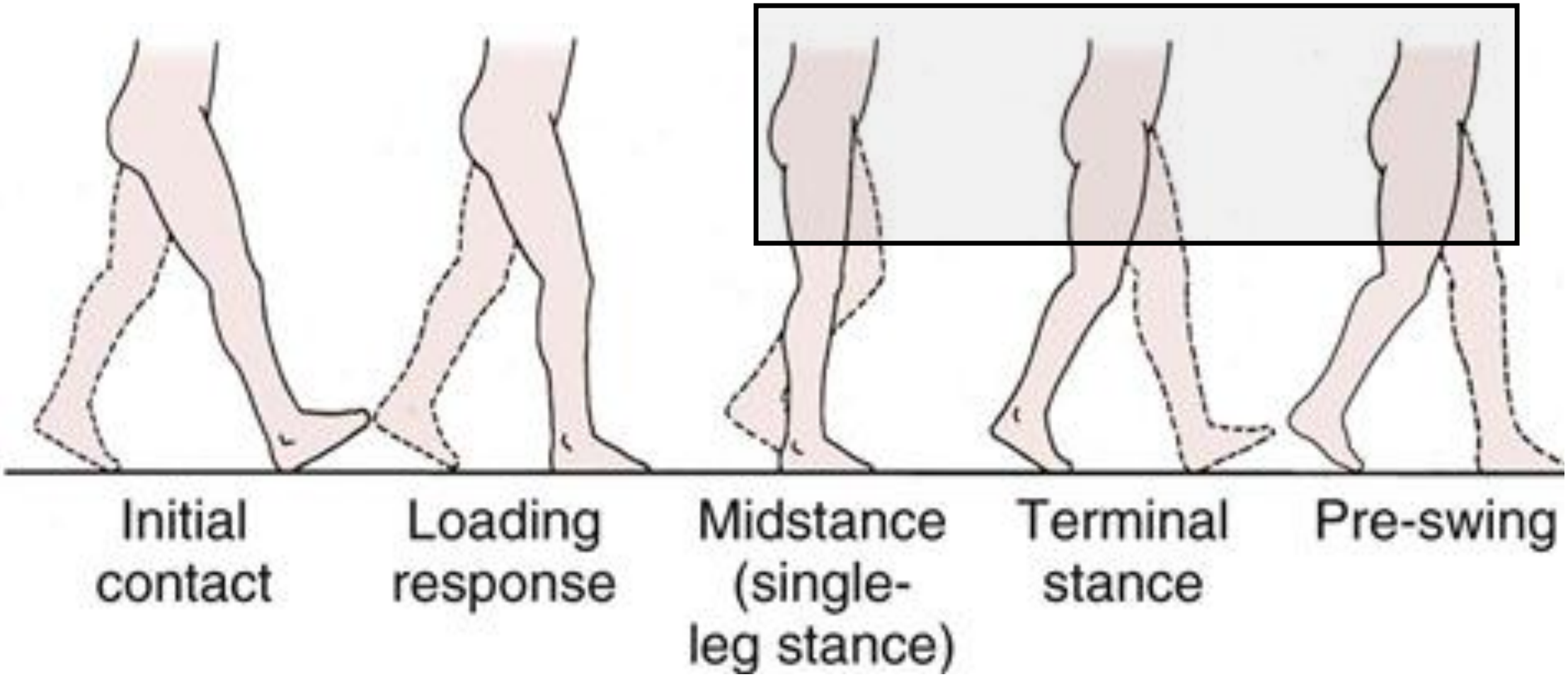
What is the hip doing?

Moving from a neutral hip to 10 degrees extension (beyond neutral)

What muscle activation would allow for control of amount of hip extension?

Eccentric hip flexors (iliopsoas) to control or slow the rate of hip extension

Moving from Midstance to Heel off (terminal stance) and Toe off (preswing)



Muscle Activation (Hip)

Acceleration (initial swing) to Midswing:

What is the hip doing?

Moving from extension into 20-30 degrees of flexion

What muscle activation would accelerate the hip into flexion?

Concentric hip flexors (iliopsoas) to advance the swing limb forward

Muscle Activation (Hip)

Midswing to Deceleration (terminal swing):

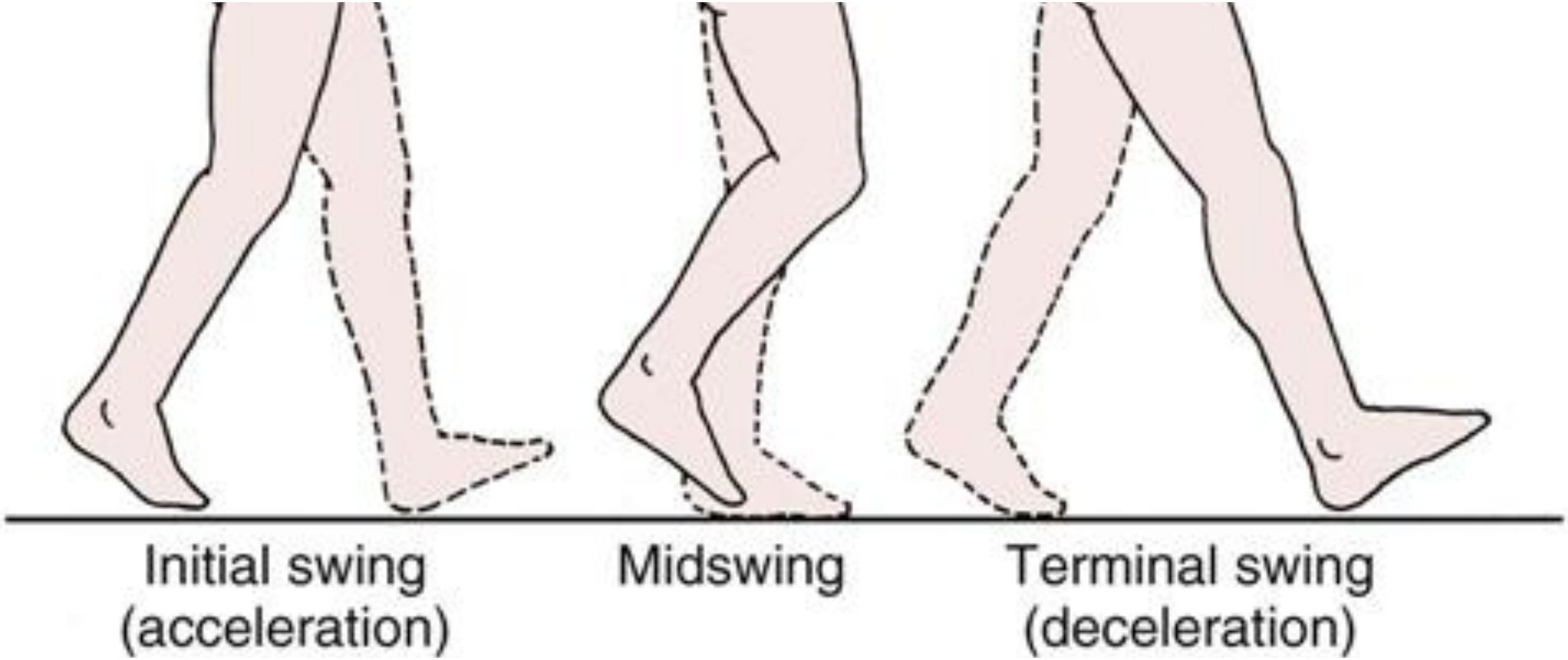
What is the hip doing?

Moving (decelerating) into 30 degrees of flexion

What muscle activation would decelerate the hip into flexion?

Eccentric hip extensors to slow the rate of hip flexion and prepare the limb for heel strike (initial contact)

Hip Motion During Swing Phase



So What If Gluteus Maximus is Weak?

Common gait deviation in stance = Posterior trunk lean

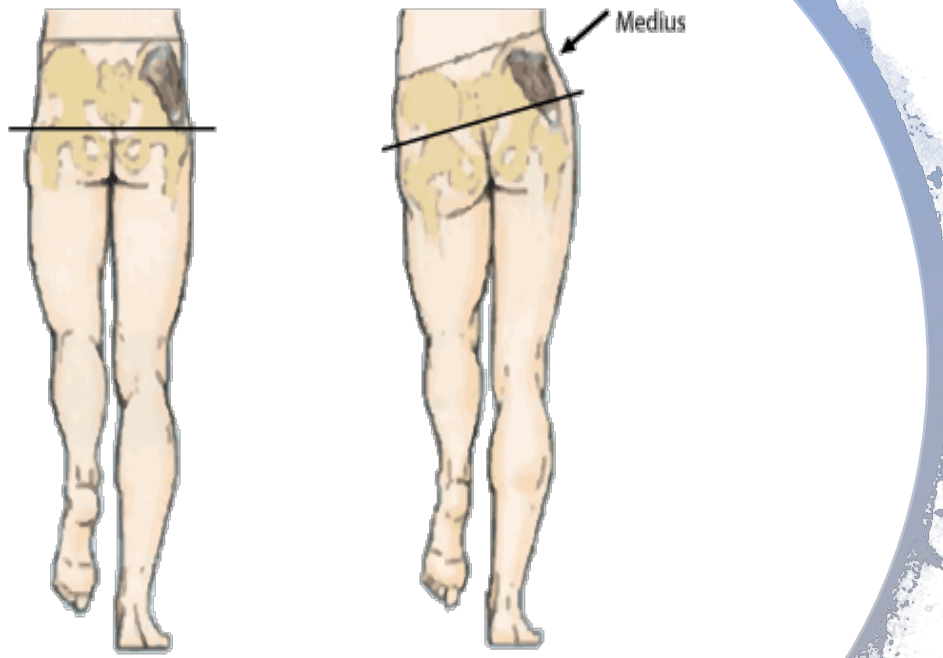
- Posterior trunk lean during early stance compensates for hip extensor (e.g., gluteus maximus) weakness by moving the line of gravity of the trunk behind the hip joint to “lock” the hip in extension

So What If Gluteus Medius is Weak?

Common gait deviation in stance =
Lateral trunk lean

- Lateral trunk lean toward the stance leg of the weak hip abductors to prevent contralateral drop of the pelvis on the side of the swing leg

- Hip abductors are **NOT** active during swing in normal gait



Trendelenburg Sign vs. Trendelenburg Gait

- It will always be the gluteus medius of the **stance** limb that is weak!
- Contralateral (opposite side) pelvic drop = Trendelenburg sign
- Lateral trunk lean toward weak stance limb = Trendelenburg gait

So What If the Hip Flexors Are Weak?

Common gait deviation in swing =
Posterior trunk lean

- Posterior trunk lean during early swing helps pull the femur forward (anteriorly) to advance the swing limb as a compensation for hip flexor (e.g., iliopsoas) weakness
- Other compensations may include hip circumduction during swing or insufficient hip flexion at terminal swing = shorter step length

Gait deviation in stance =

Poor eccentric control of the rate of hip extension during late stance phase

Conclusion

- **Identify the motion** that is occurring during each transition of the gait cycle **to understand the muscle activation needed**
- **Ask yourself:** “Is it overcoming gravity (concentric) or is gravity or momentum helping to control the rate of the movement (eccentric)?”
- **Seek to understand gait** transitions to diminish the need for memorization
- Understanding muscle activation helps **“connect the dots”** to understanding gait deviations

Question #1

A patient presents with significant weakness of the quadriceps with a muscle grade of Poor plus (2+/5). During examination of gait, which of the following deviations would the therapist **MOST** likely expect to observe?

1) Posterior trunk lean in early stance
2) Anterior trunk lean in early stance
3) Circumduction during swing phase
4) Vaulting on the contralateral limb

Question #2

Which of the following muscles are **MOST** responsible for keeping the right side of the pelvis from dropping during the stance phase of gait on the left leg?

1) Left hip abductors
2) Right hip abductors
3) Left hip adductors
4) Right hip adductors

Question #3

A physical therapist examines the gait of a patient who sustained an injury to the deep peroneal nerve. Which of the following gait deviations would the therapist **MOST** likely expect to observe between heel strike (initial contact) and foot flat (loading response)?

1) Hyperextension of the knee
2) Posterior lean of the trunk
3) Excessive pronation of the foot
4) Foot slapping to the ground

Question #4

Which of the following gait deviations would **MOST** likely be used by a person wearing a knee immobilizer on the right lower extremity?

1) Vaulting gait on the right leg
2) Steppage gait of the right leg
3) Circumduction of the right hip
4) Uncompensated Trendelenburg gait on the left

Question #5

A physical therapist assistant observes a patient lean backwards during the early stance phase of gait. Weakness in which of the following muscles is **MOST** likely causing this gait deviation?

1) Gluteus maximus
2) Gluteus medius
3) Quadriceps
4) Iliopsoas

Question #6

While performing gait analysis, a physical therapist observes excessive pronation during foot flat (loading response) and a lack of supination as a lever for “push-off” in late stance. Weakness in which of the following muscles should the therapist **MOST** expect to be the cause of the observed gait deviations?

1) Gastrocnemius
2) Tibialis posterior
3) Fibularis longus
4) Quadratus plantae

Questions?

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