Normal Gait

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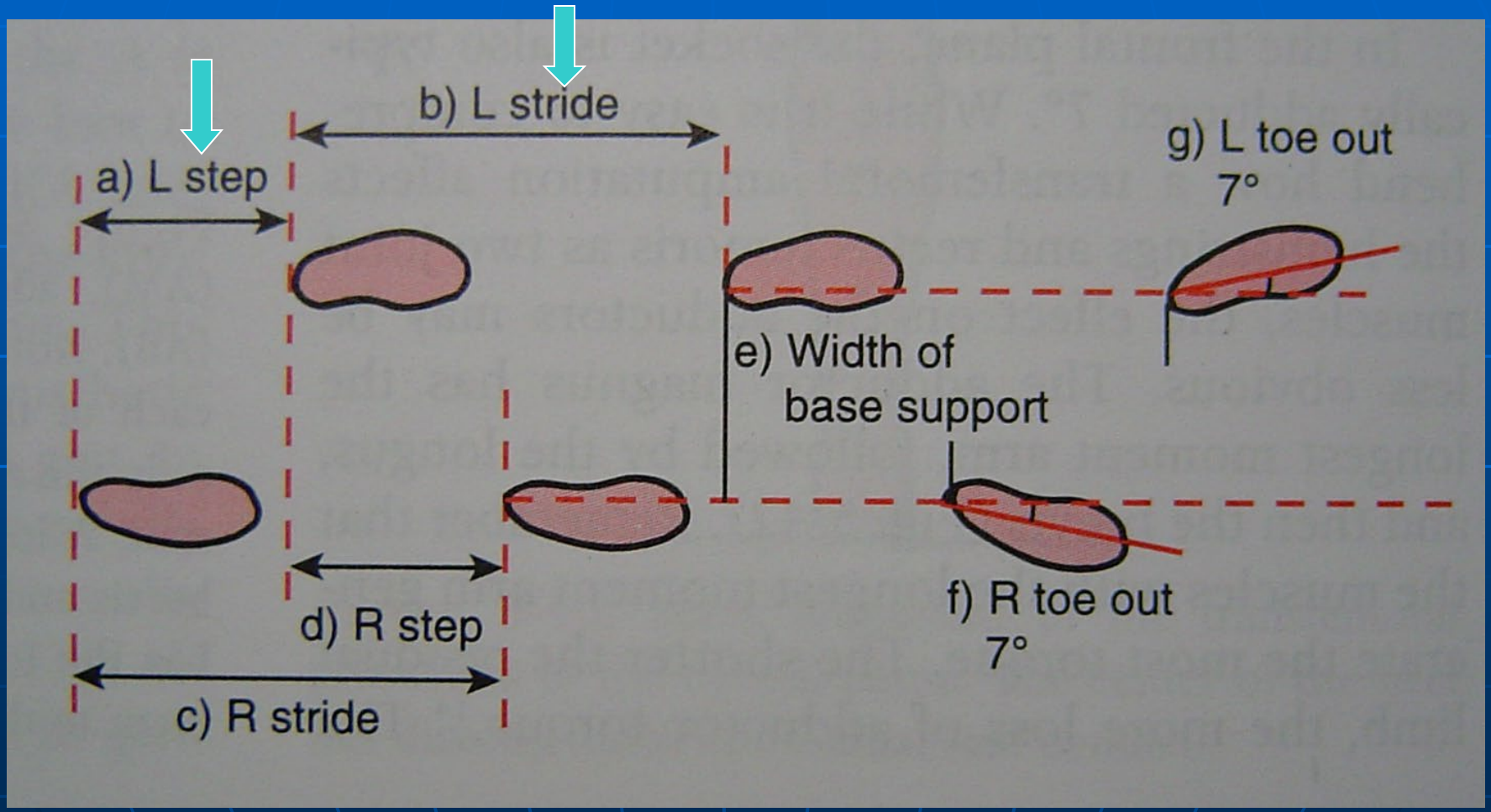
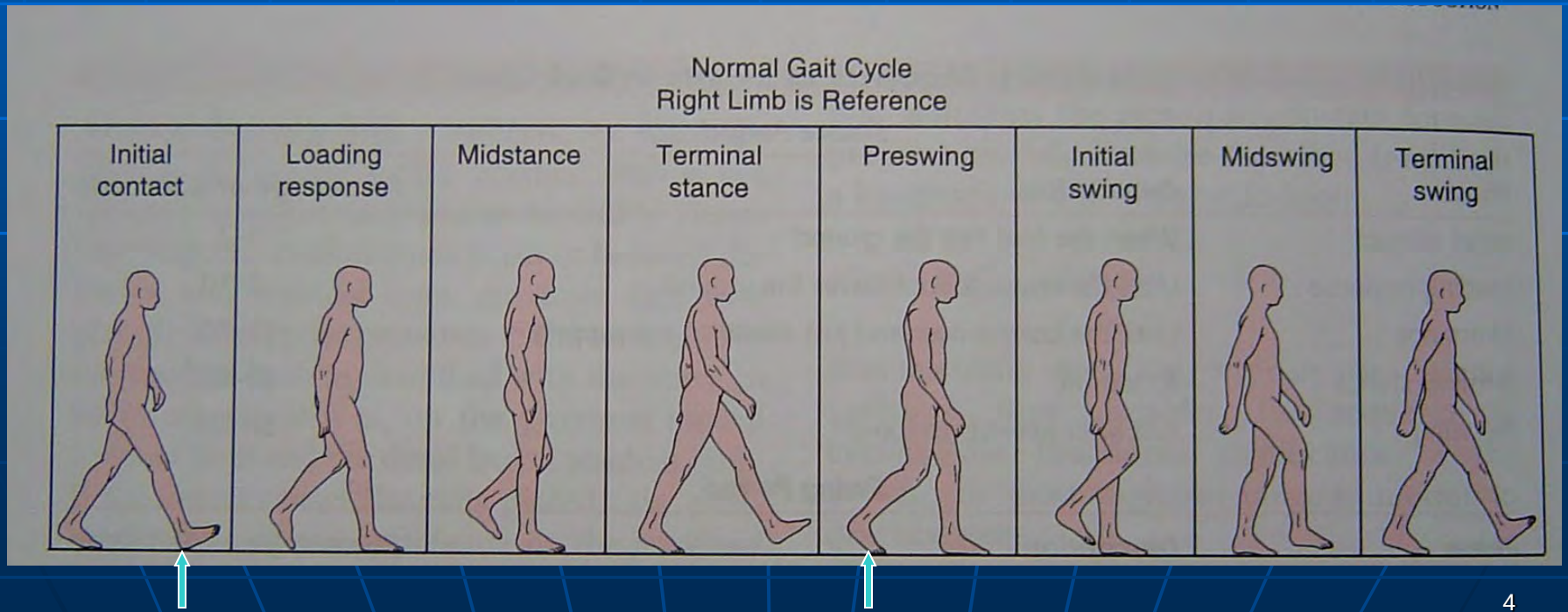
Critical Gait Parameters

- Average walking speed = 2-3 mph (60-80m/min)
- Average cadence = 80-110 steps/min
- Average step length = 30 cm
- Average stride length = 60 cm
- Stance/swing (1 leg) = 60/40
- Single/double limb support = 80/20
- Running has no double limb support

Step or Stride?
R step + L step = stride



Phases of the Gait Cycle (1 leg)
Stance Phase – 60%
Swing Phase – 40%



Comparison of R leg to L leg 80/20 rule

Table 5-2. Summary of Gait Phases

R	0–10%	10–30%	30–50%	50–60%	60–73%	73–87%	87–100%
	(10%)	(20%)	(20%)	(10%)	(13%)	(14%)	(13%)
R	Initial & loading	Midstance	Terminal stance	Preswing	Initial swing	Midswing	Terminal swing
L	Preswing	Initial swing	Midswing	Terminal swing	Initial & loading	Midstance	Terminal stance
L	0–10%	10–23%	23–37%	37–50%	50–60%	60–80%	80–100%
	(10%)	(13%)	(14%)	(13%)	(10%)	(20%)	(20%)

Key: *Swing* *Stance*

Three Important Gait Factors

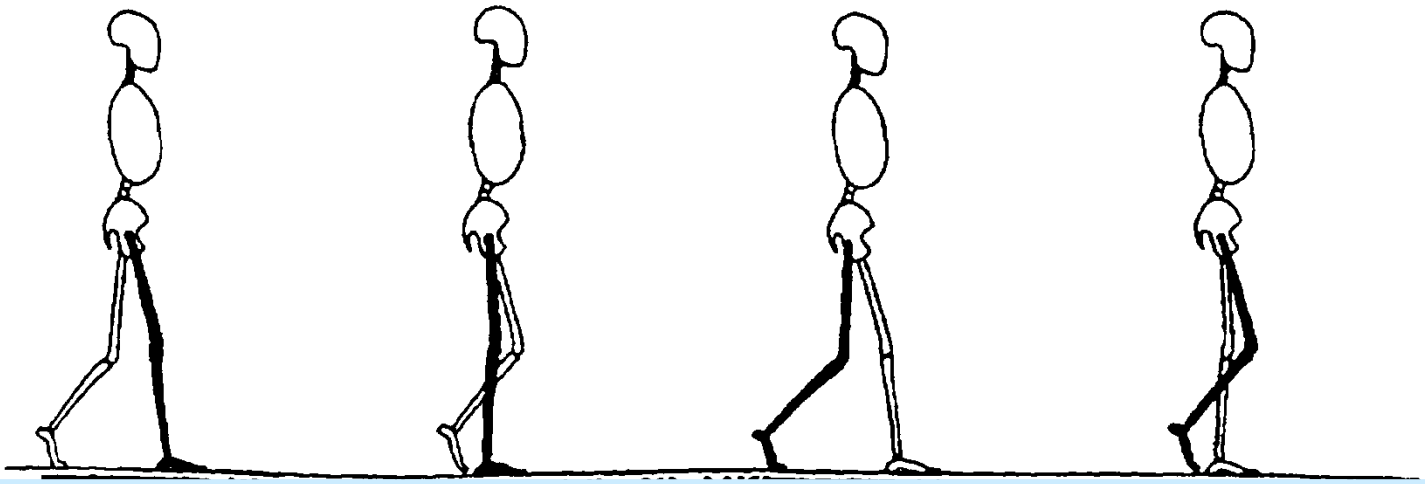
- Forward Progression
- Stance Stability
- Conservation of Energy

Methods of Analyzing Gait

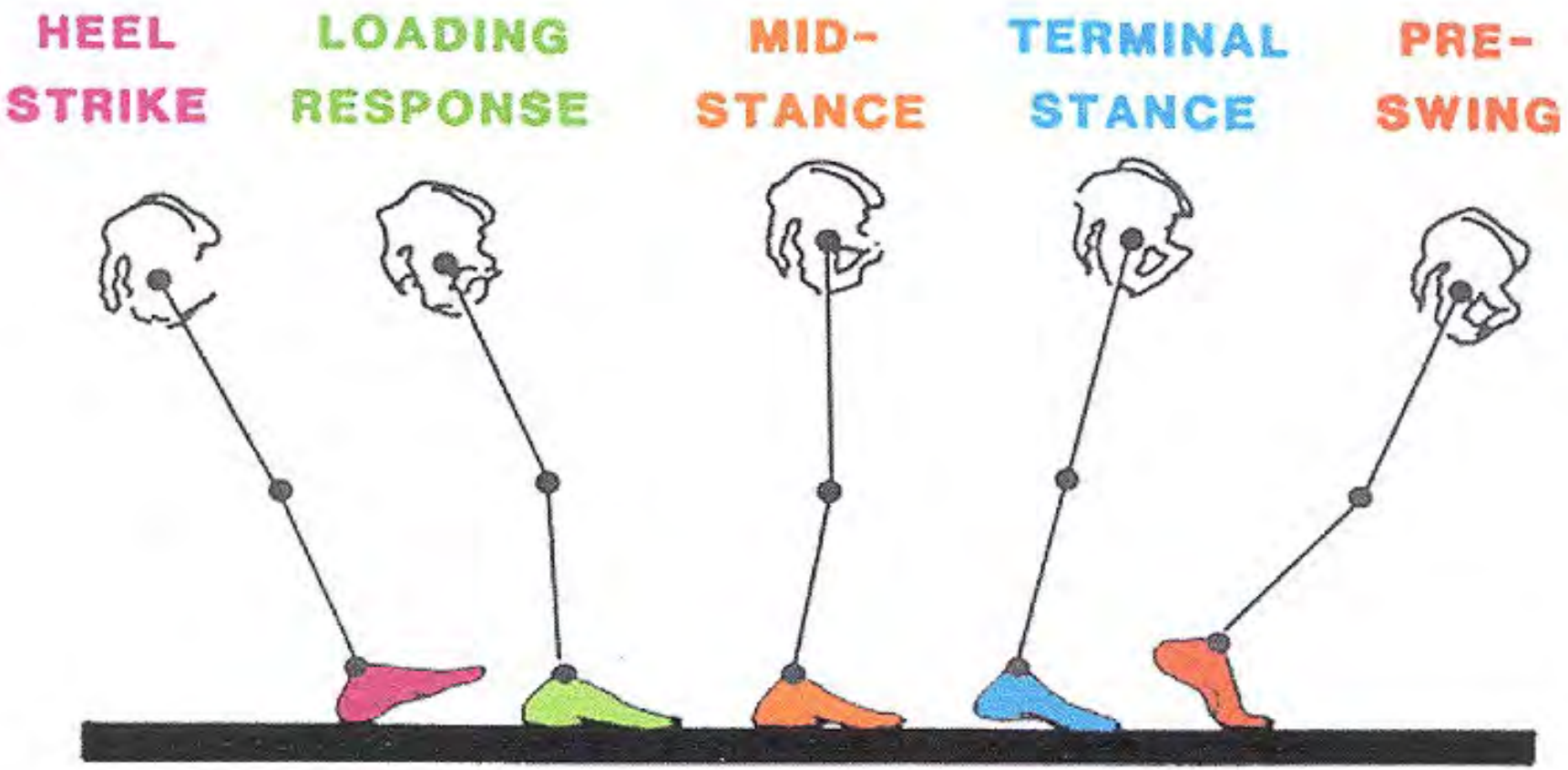
- **Kinematics** = observing or measuring the position of joints and segments through each phase of gait (visual gait analysis)
- **Kinetics** = measuring the Ground Reaction Force at each joint and then calculating the muscle activity or soft tissue resistance present to stabilize the joint

Gait Analysis Basic Training

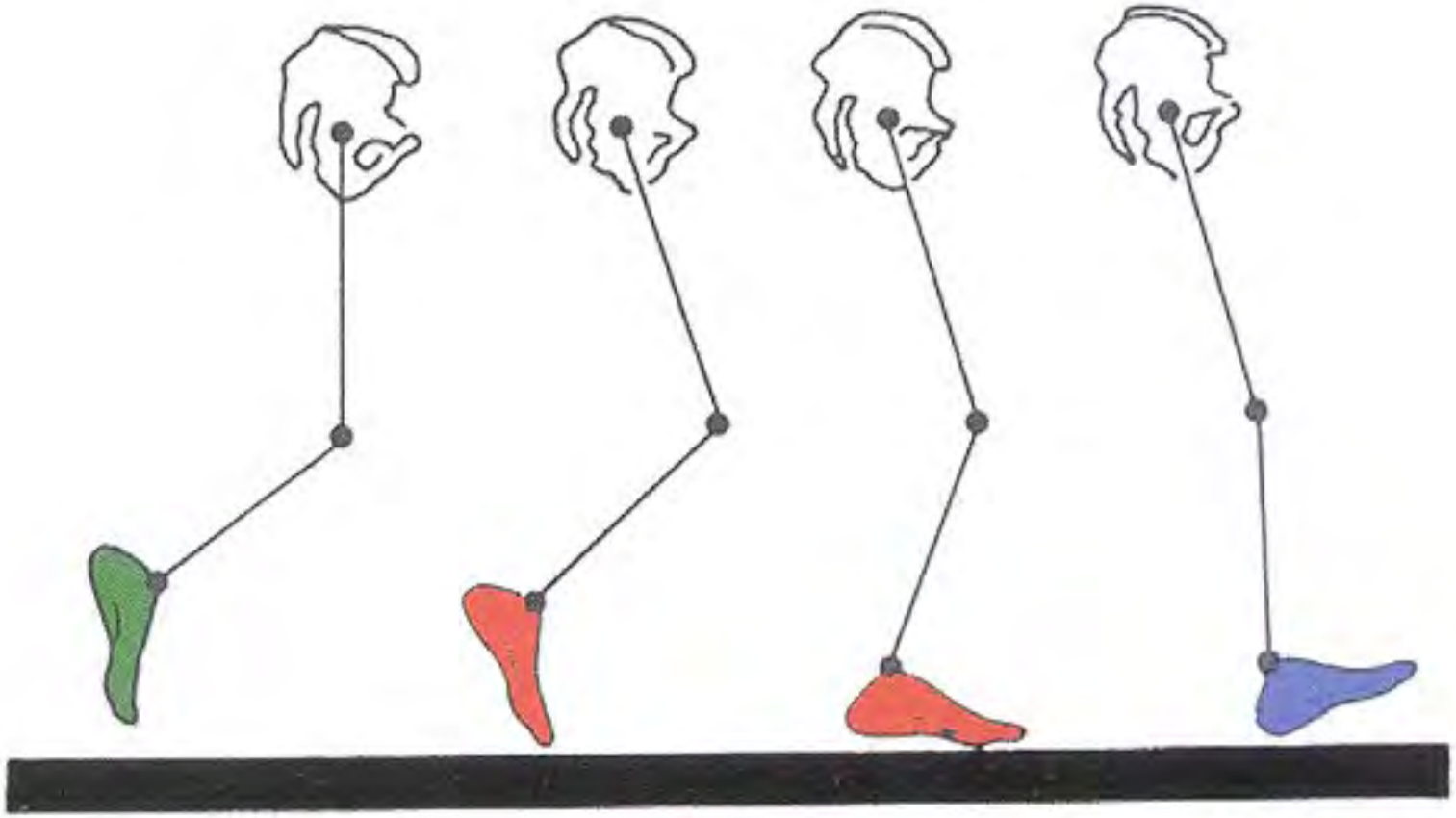
- Assess only one joint at a time
- Look at early stance, late stance, then swing
- Separate kinetics from kinematics
- KEEP IT SIMPLE!



Normal Human Locomotion: Sagittal Plane Gait Kinematics

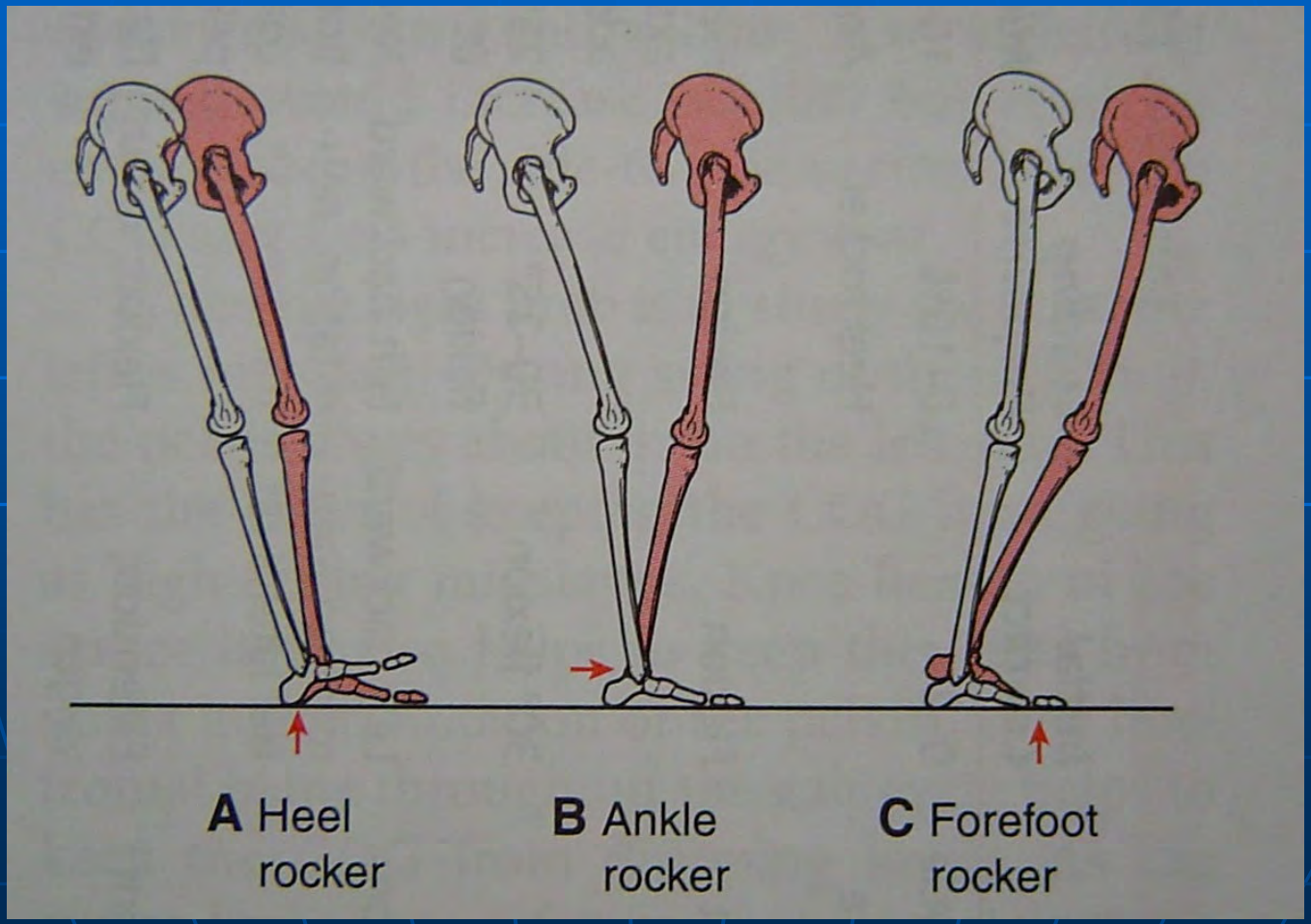


STANCE PHASE



SWING PHASE

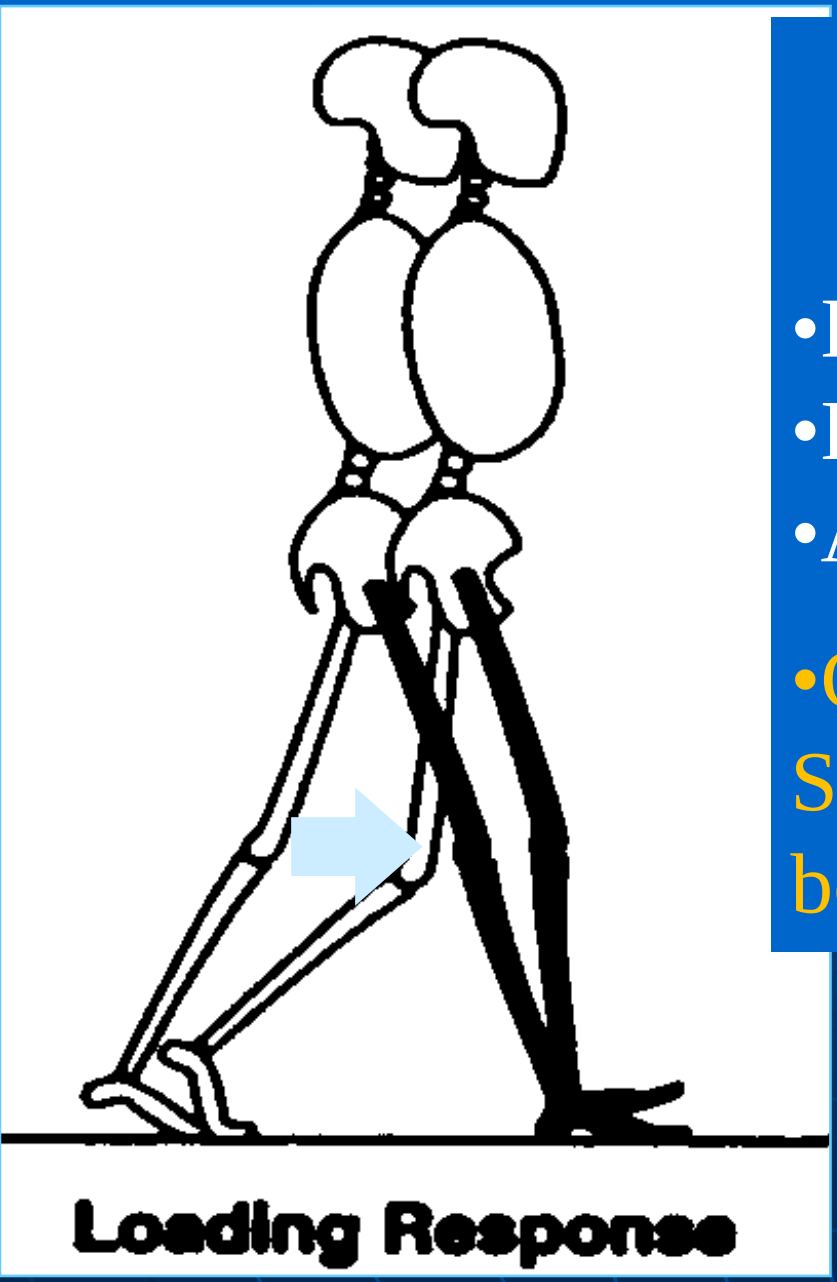
Rockers or Pivot Points in Stance



Initial Contact

Initial Contact:

- Double Support
- Hip = Flexed 30*
- Knee = Extended
- Ankle = Neutral
- Goal = Begin Stance

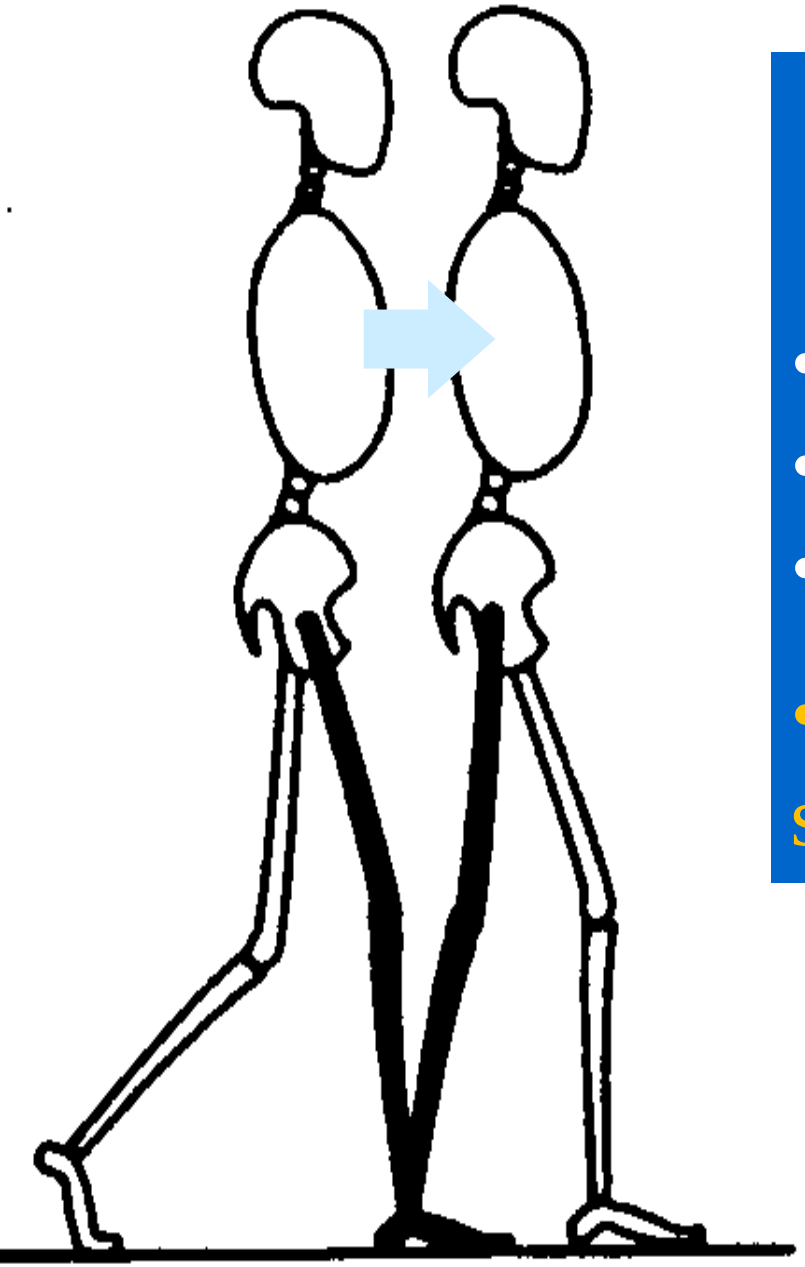


Loading Response:

•Double Support

- Hip = Flexed
- Knee = Flexing 5-10*
- Ankle = Plantarflexing to 20*

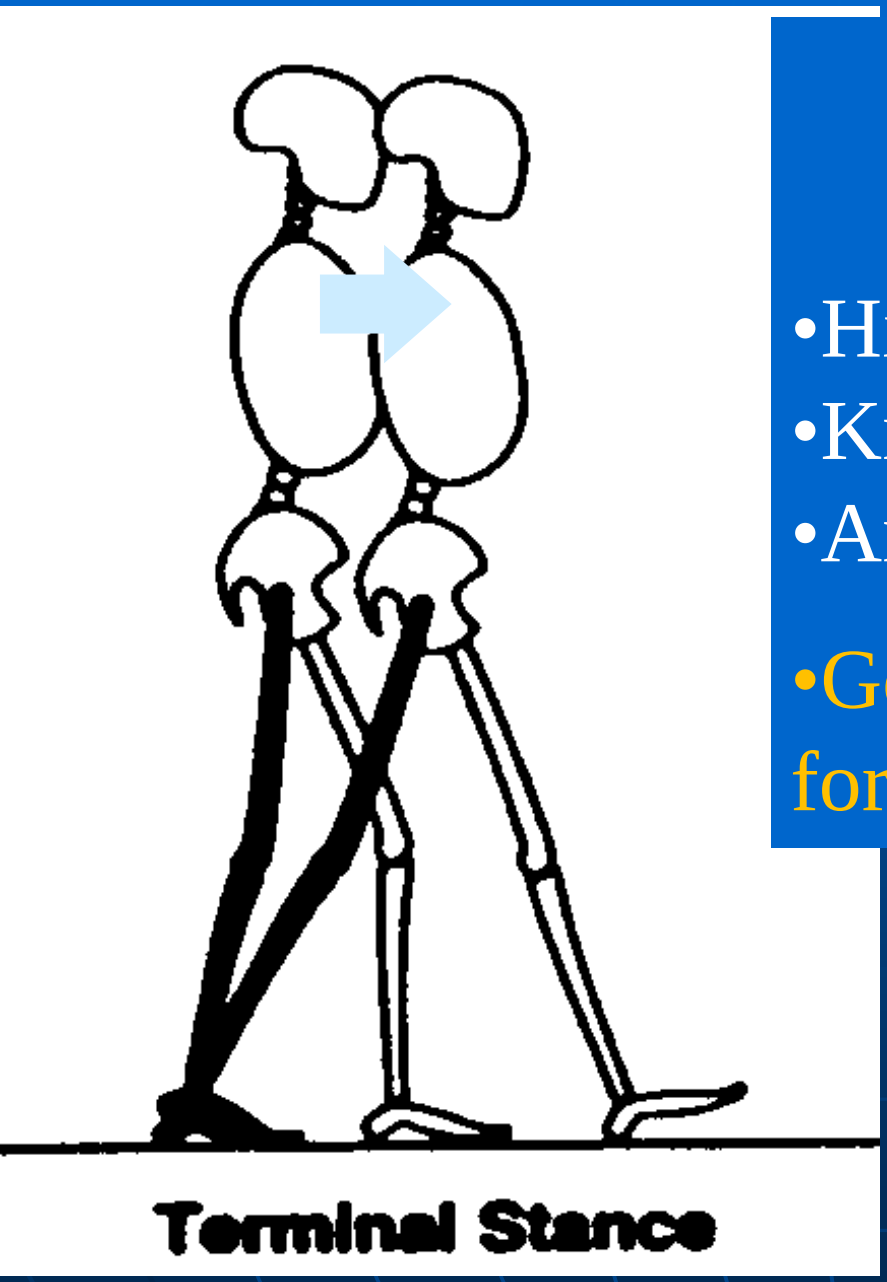
- Goals = Weight Acceptance, Shock Absorption, Advance body over Heel Rocker



Mid Stance

Mid Stance:

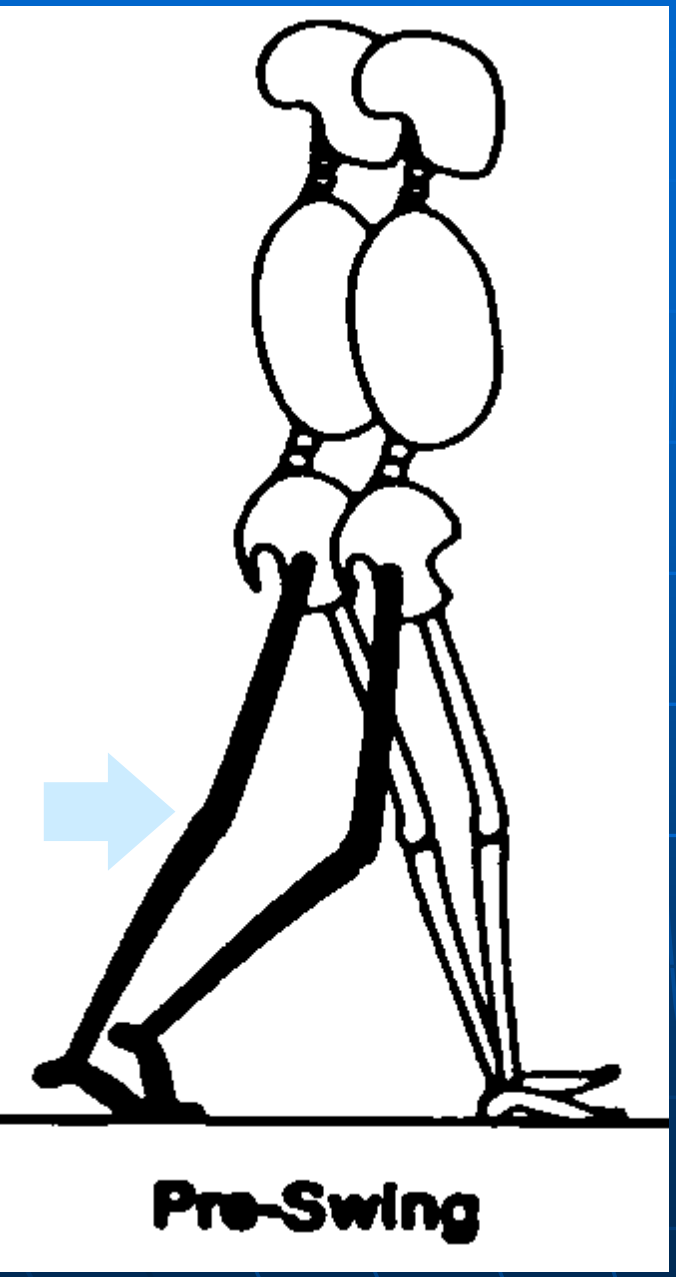
- Single Support
- Hip = Extending
- Knee = Flexed 5-10*
- Ankle = Dorsiflexing
- Goal = Advance body over stationary foot, ankle rocker



Terminal Stance:

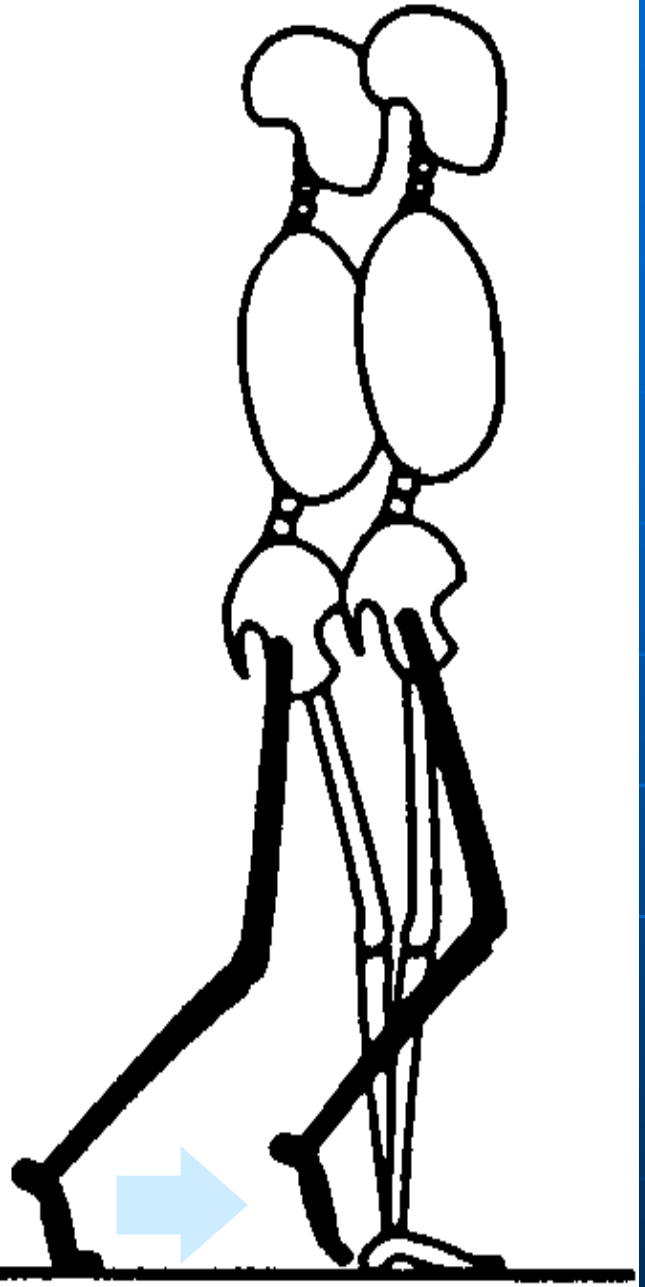
- Single Support
- Hip = Extending 15-30*
- Knee = Extend, then Flex
- Ankle =15* DF to Neutral

- Goal = Advance body over forefoot rocker



Pre Swing:

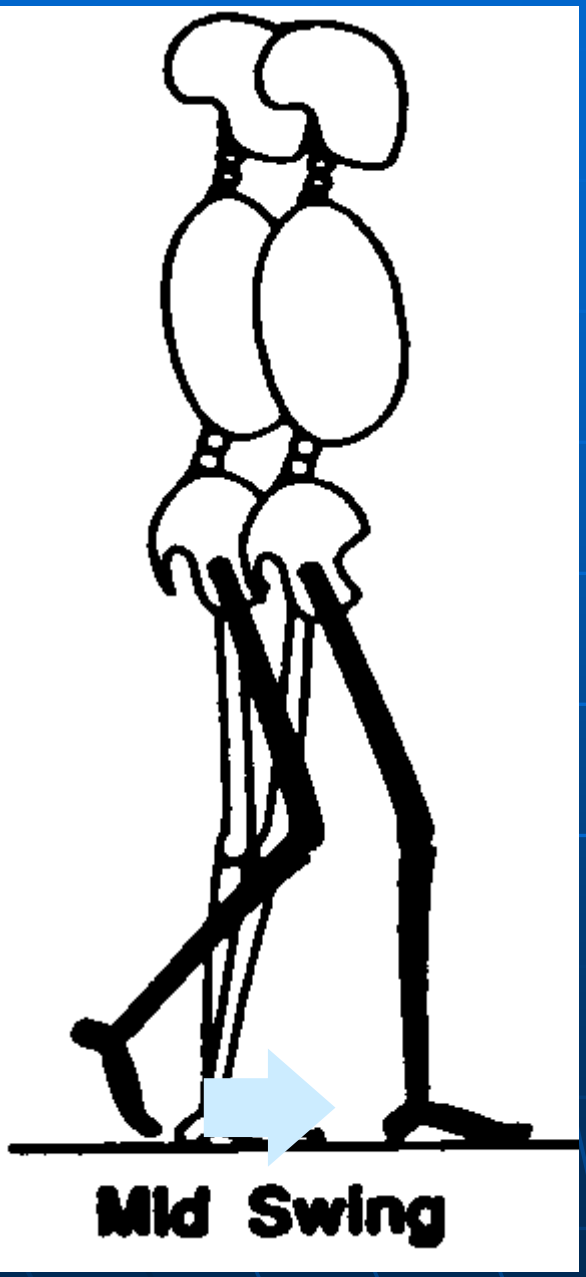
- Double Support
- Hip = Flexing
- Knee = Flexing 30-40*
- Ankle = Plantarflexing 20-30*
- Goal = Prepare for Swing, transfer load to other limb



Initial Swing

Initial Swing:

- Single Support
- Hip = Flexing
- Knee = Flexing up to 65*
- Ankle =Dorsiflexing to 0*
- Goal = Clear foot and advance limb



Mid Swing:

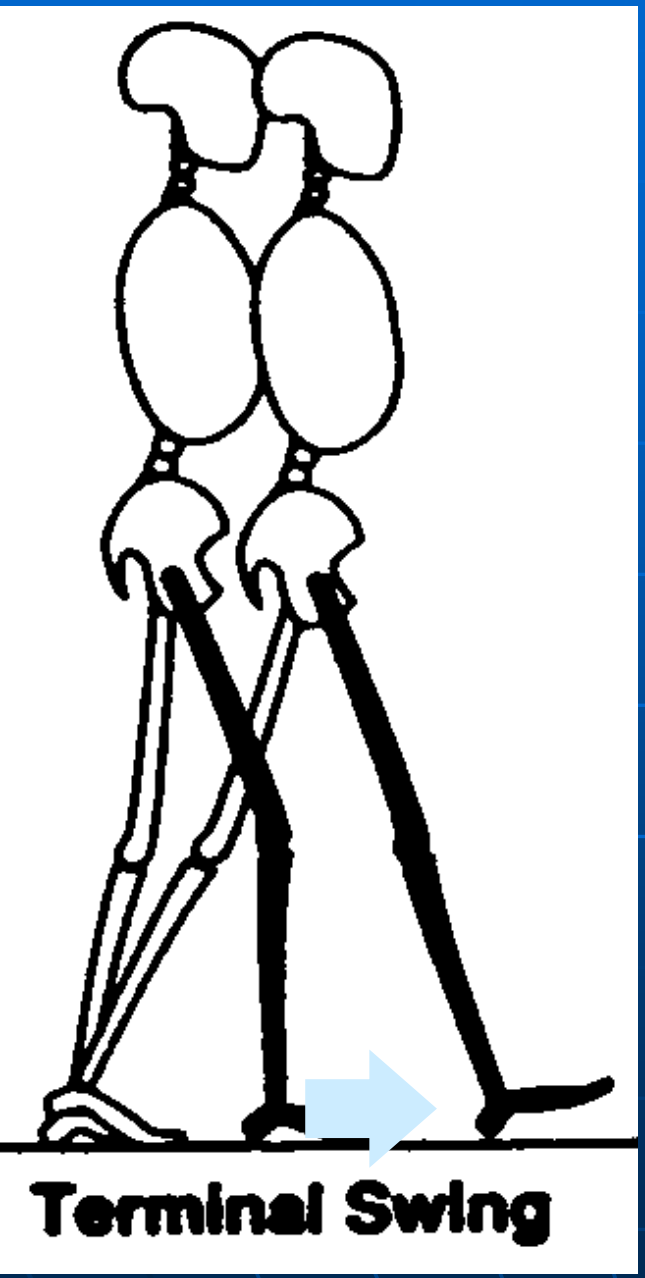
•Single Support

•Hip = Flexing to 30*

•Knee = Extending

•Ankle =Dorsiflexing to 0*

•Goal = Advance limb and clear foot



Terminal Swing:

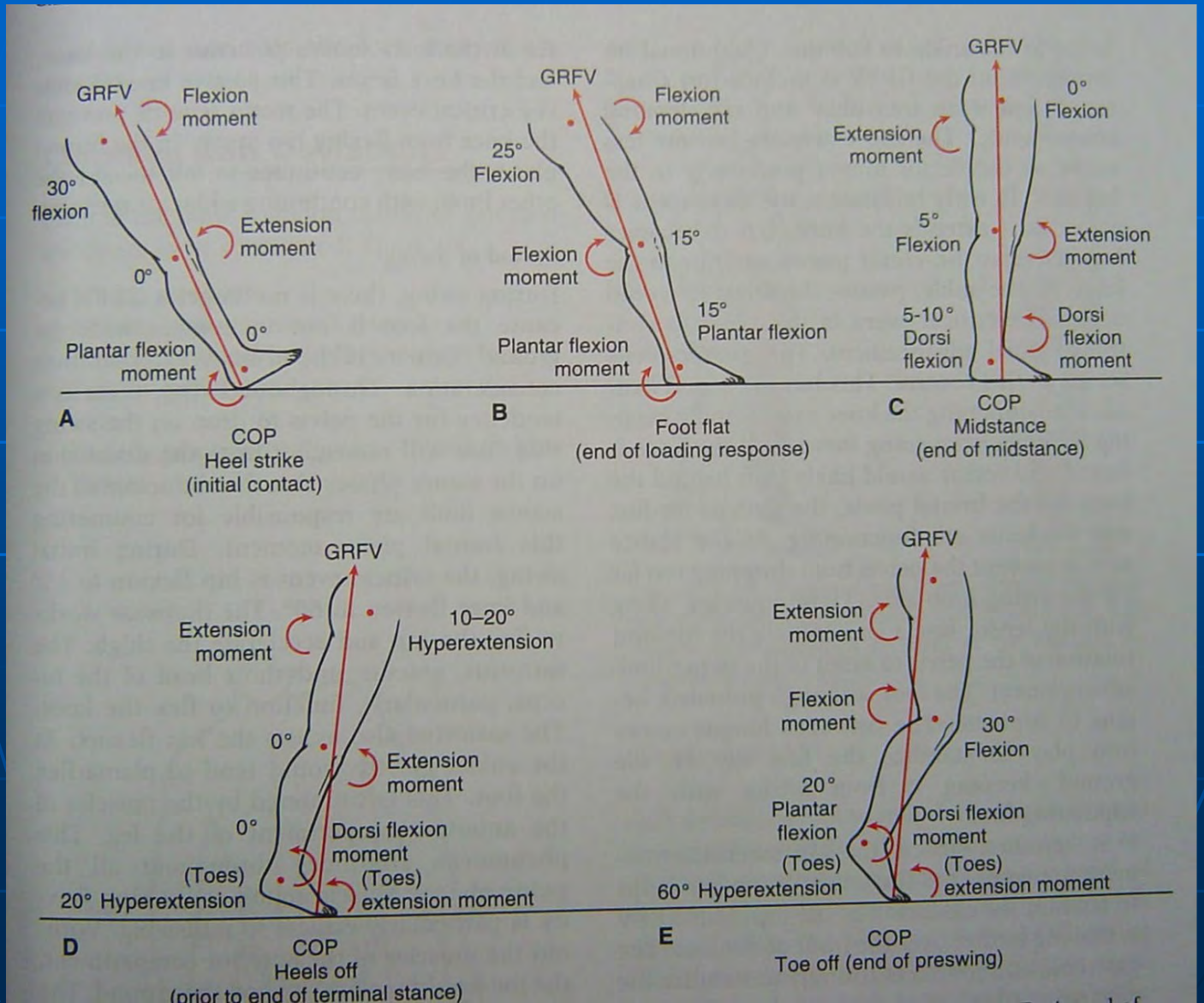
- Single Support
- Hip = Flexed 30*
- Knee = Extending
- Ankle = Neutral
- Goal = Advance limb

Initial Contact

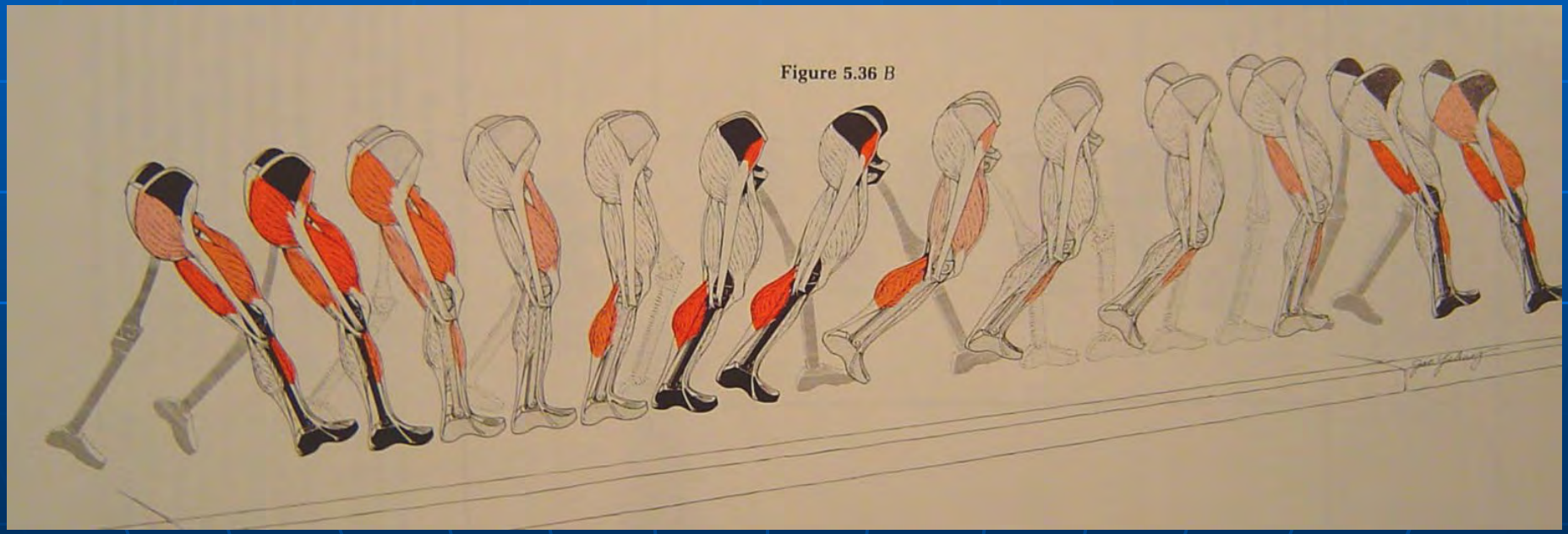
Initial Contact:

- Double Support
- Hip = Flexed 30*
- Knee = Extended
- Ankle = Neutral
- Goal = Begin Stance

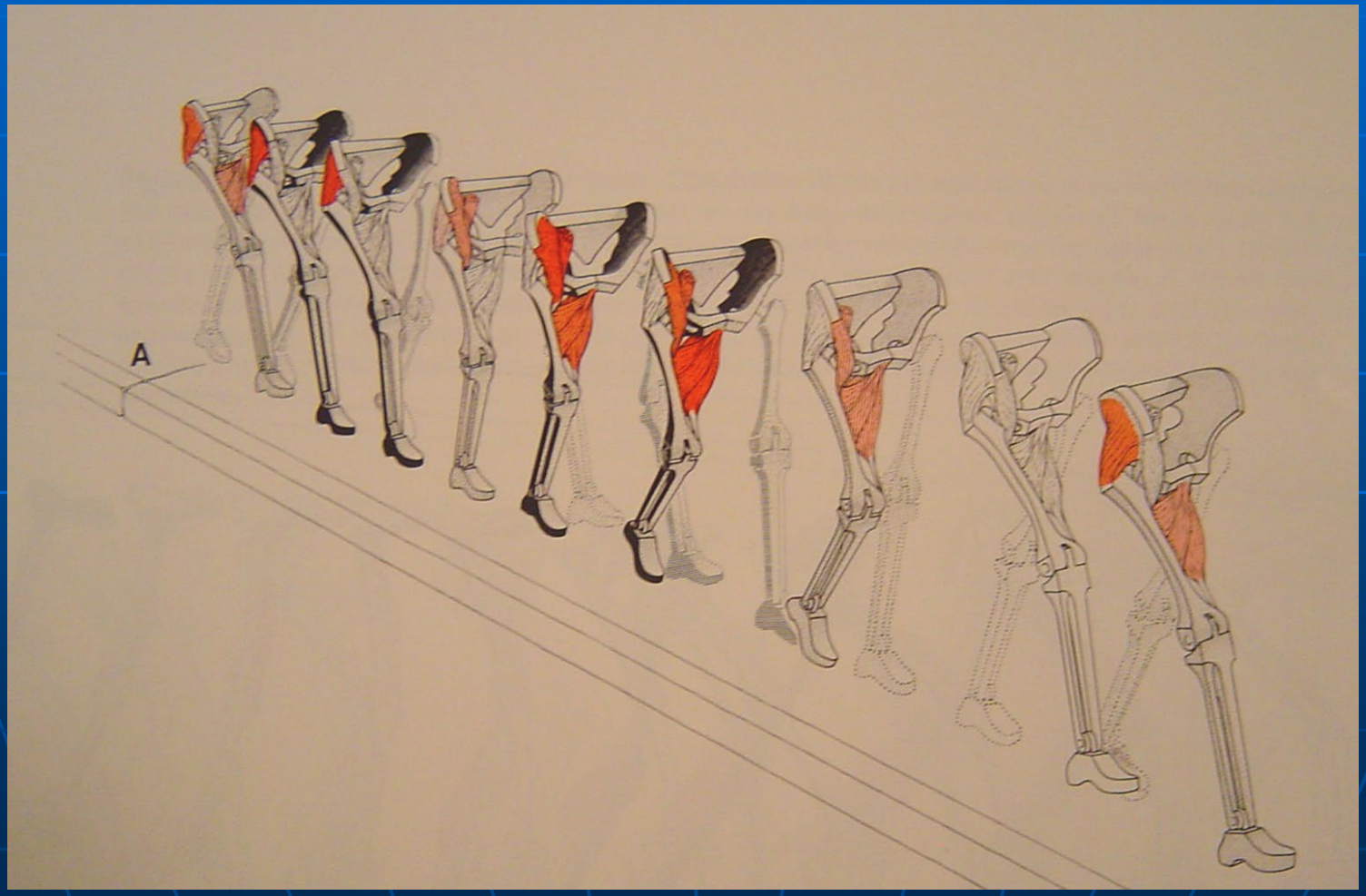
Kinetics of Stance Phase



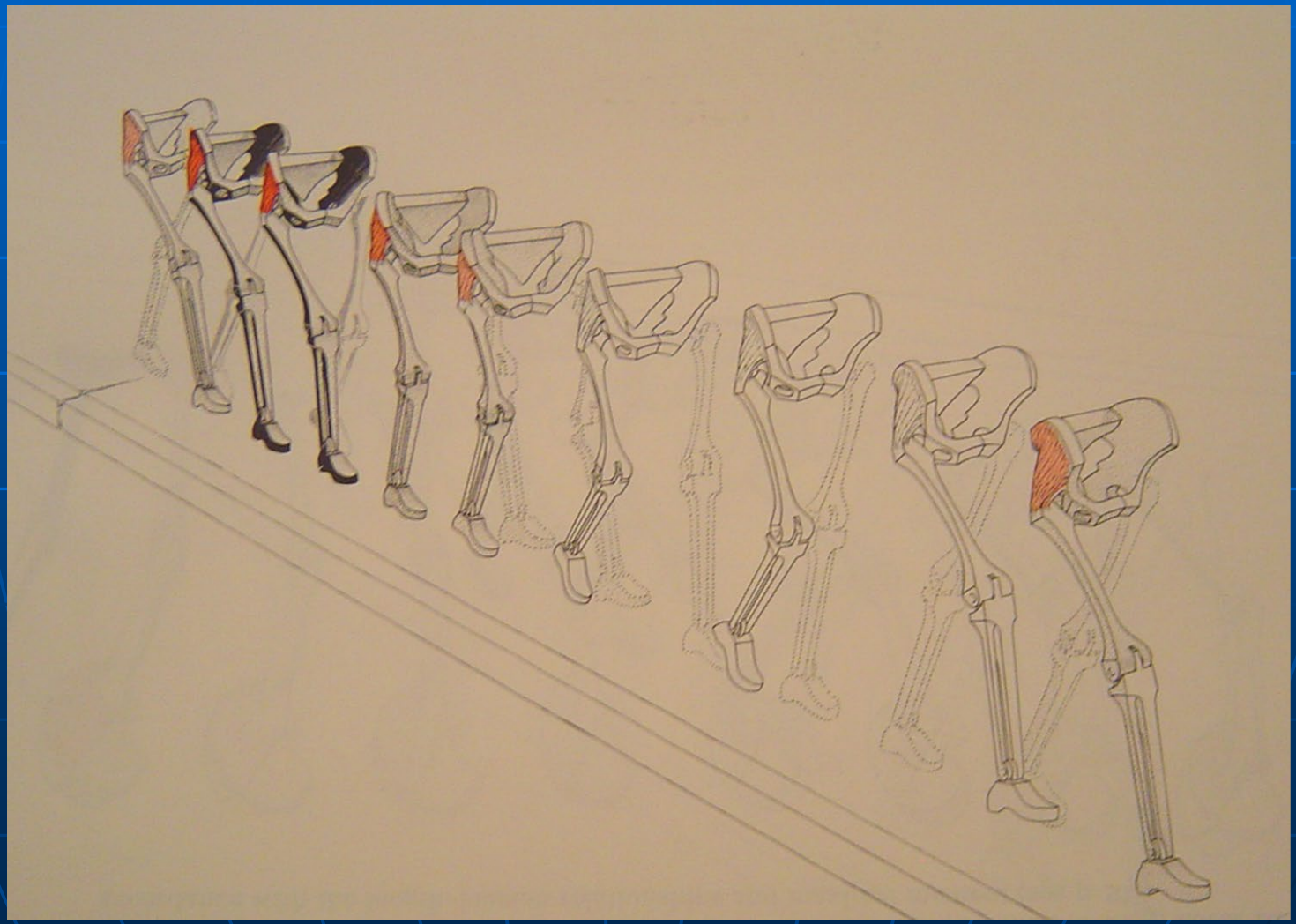
Activity of All Major Muscles



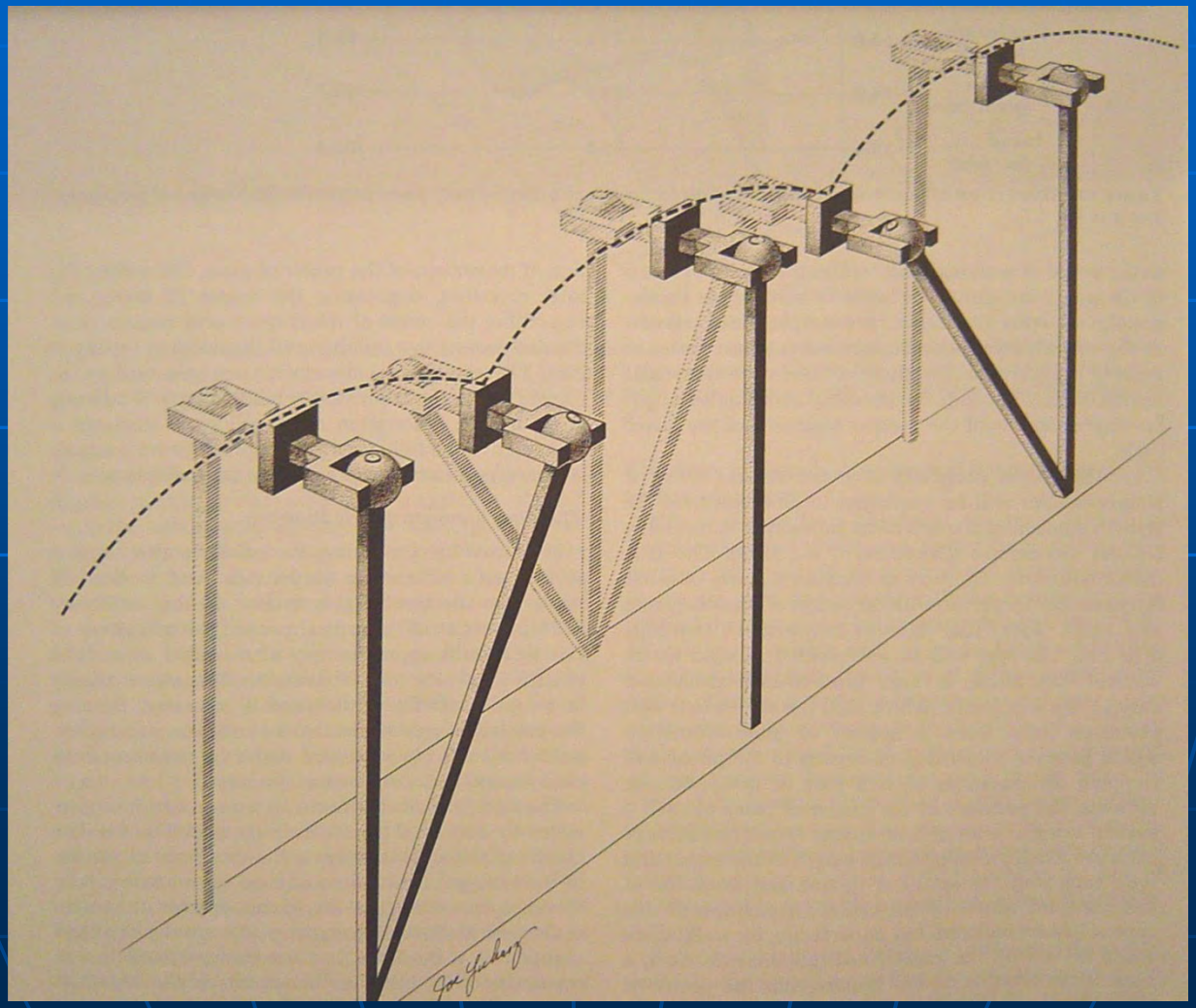
Activity of All Major Muscles



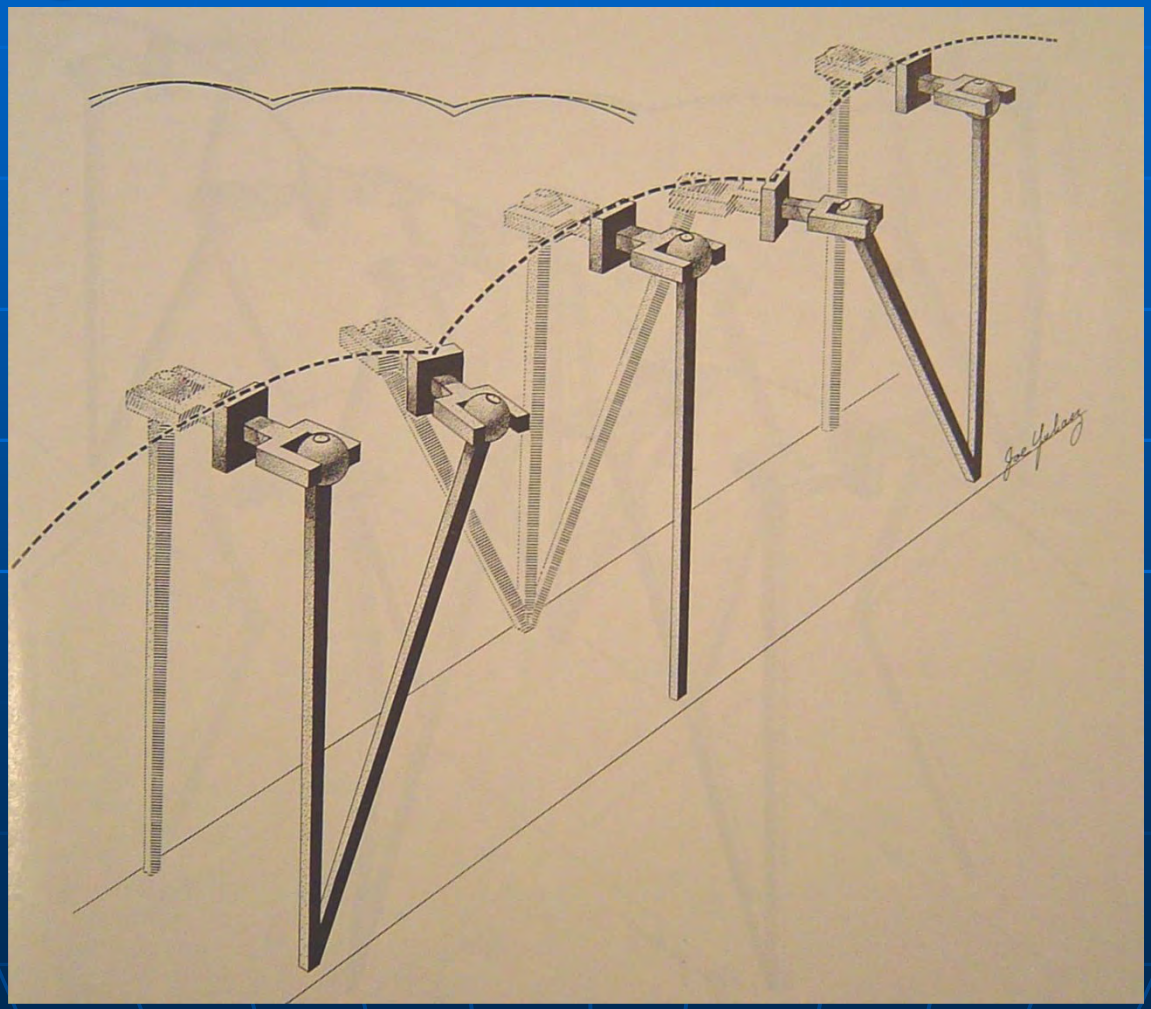
Hip Abductor Activity



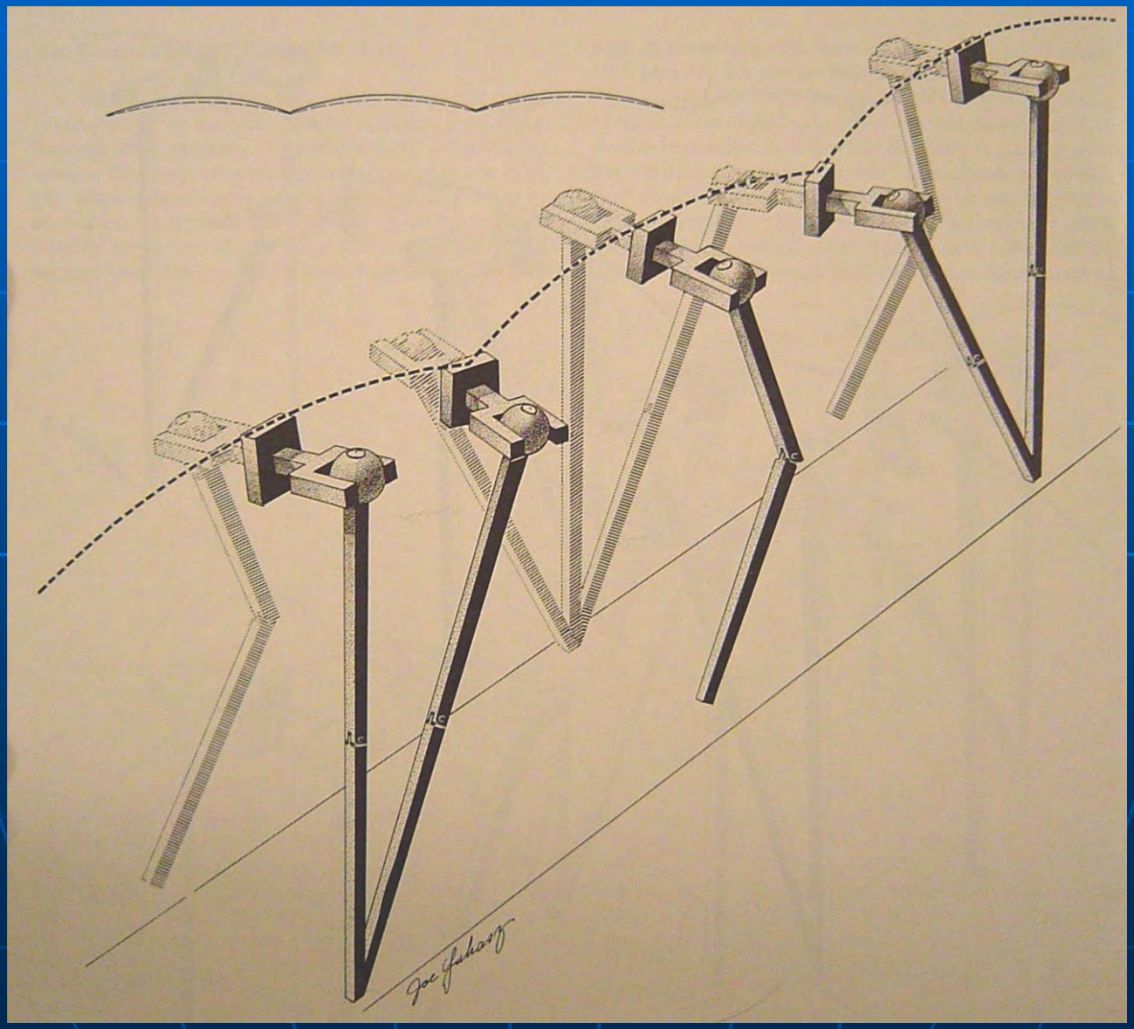
Determinants of Gait
Stick Figure Model



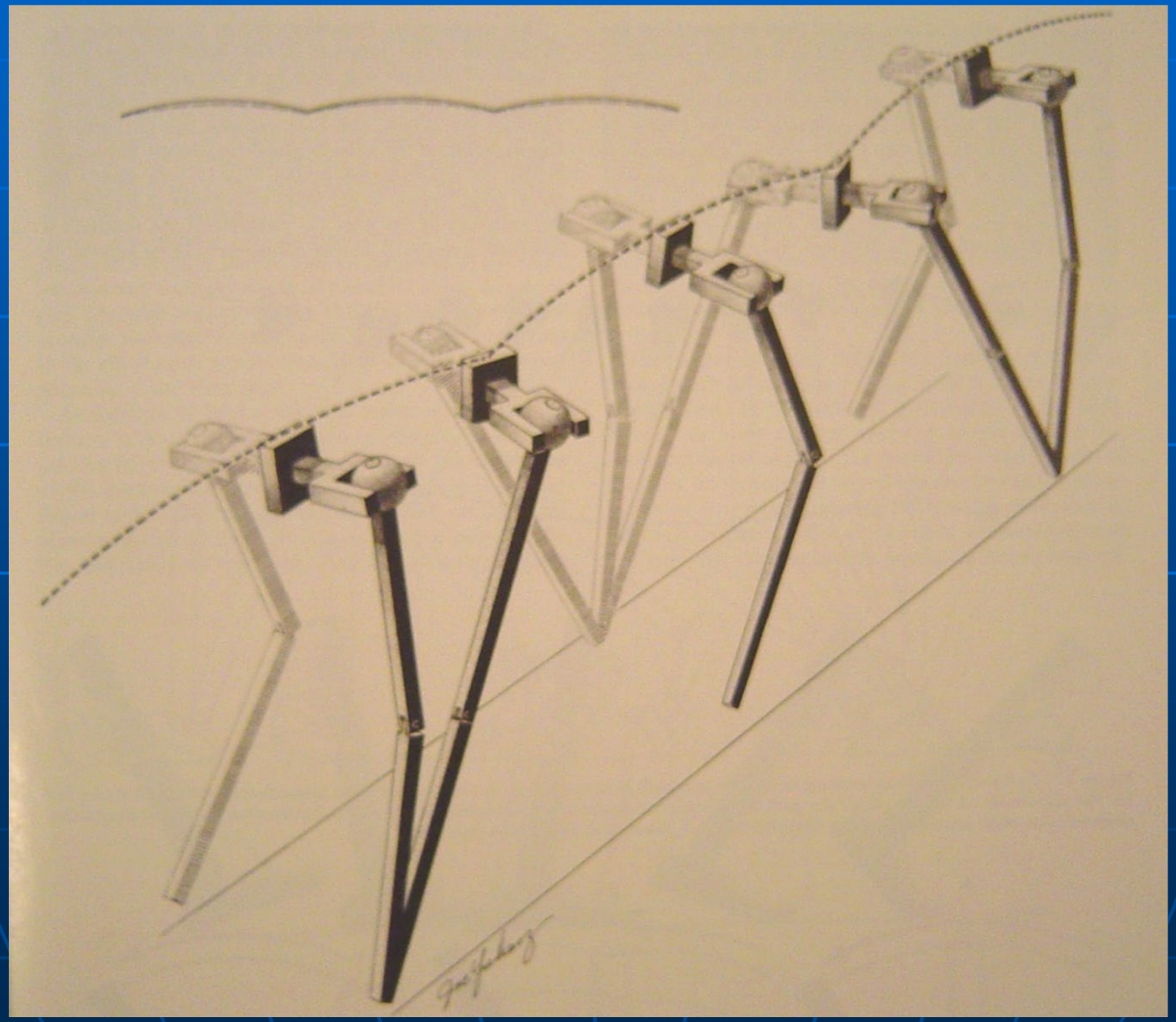
1.Pelvic Rotation Lengthens Limb at IC and PS



2.Pelvic Tilt
Shortens Limb at MS



3.Knee Flexion in Stance Shortens Limb at MS



4&5.Foot and Ankle Motion Lengthens and Shortens Limb

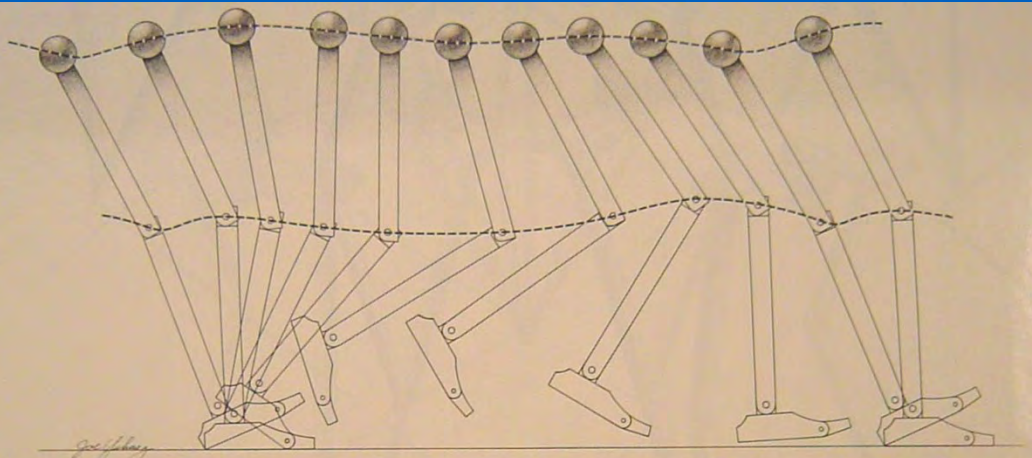


Figure 1.7. Pathway of knee in walking at moderate speed. Note that there is a slight elevation immediately after heel strike, but for the remainder of stance phase the pathway is relatively straight and shows only a slight declination from the horizontal. (Reproduced, with permission, from Saunders et al. *J. Bone Joint Surg. 35-A*:543, 1953.)

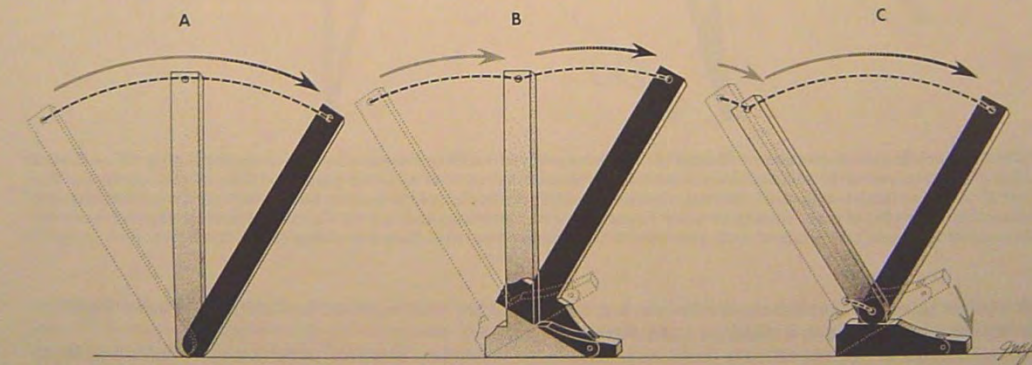
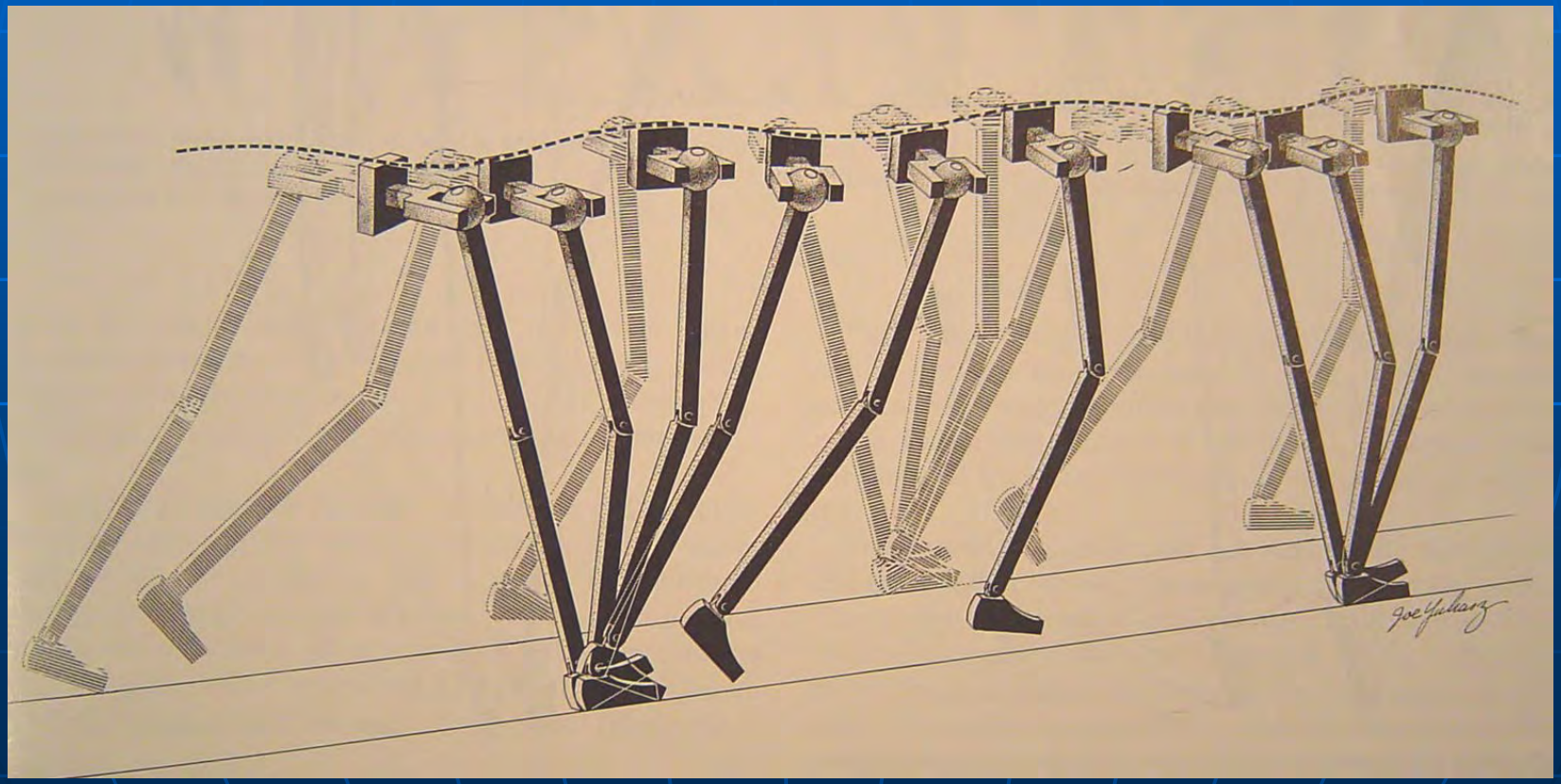
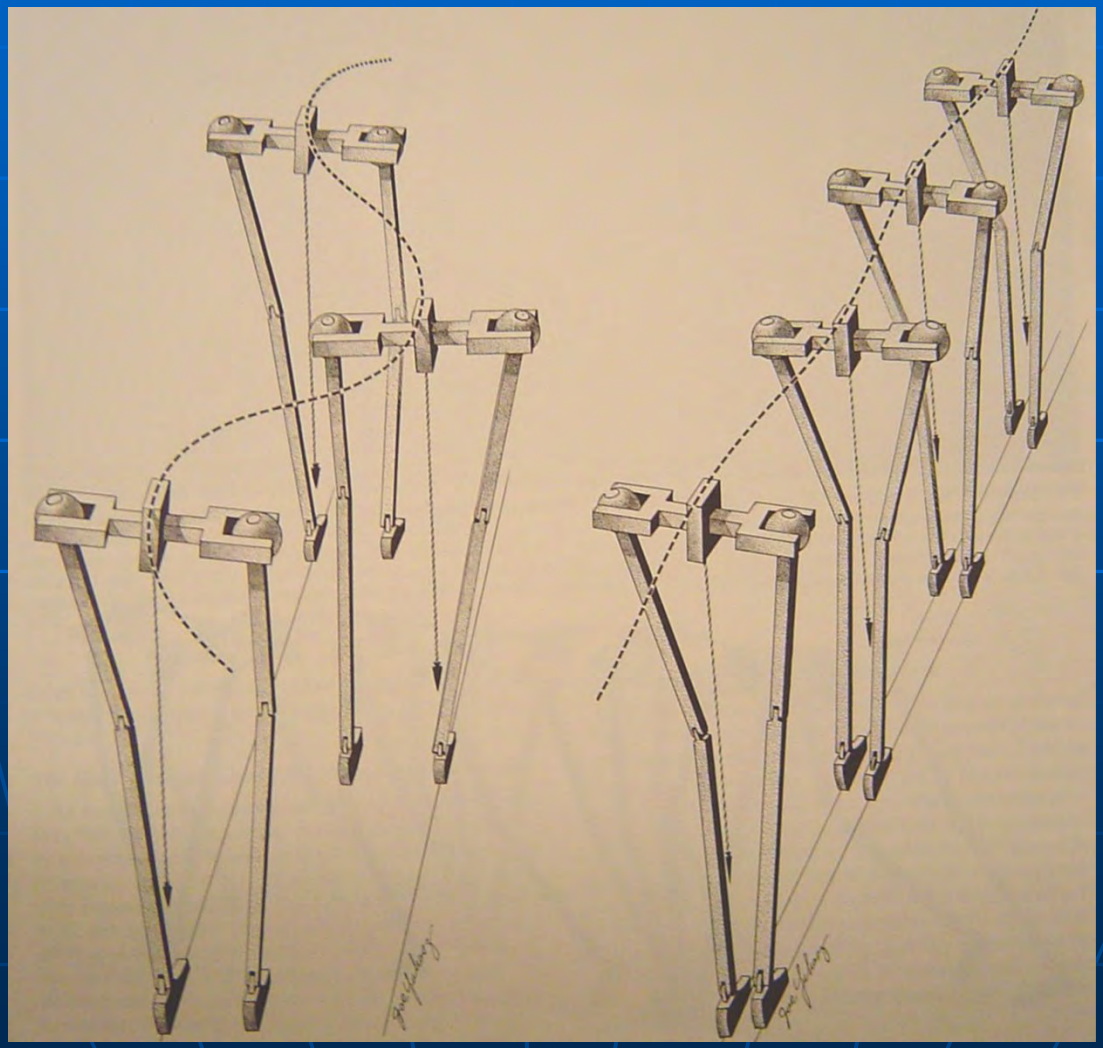


Figure 1.8. Effect of foot on pathway of knee. *A*, Arc described when there is no foot. *B*, Effect of foot without ankle. Note that the pathway now comprises two intersecting arcs. However, it does not fall abruptly at the end of stance and begins to resemble the normal pathway. *C*, Effect of foot with flail ankle. (Reproduced, with permission, from Saunders et al. *J. Bone Joint Surg. 35-A*:543, 1953.)

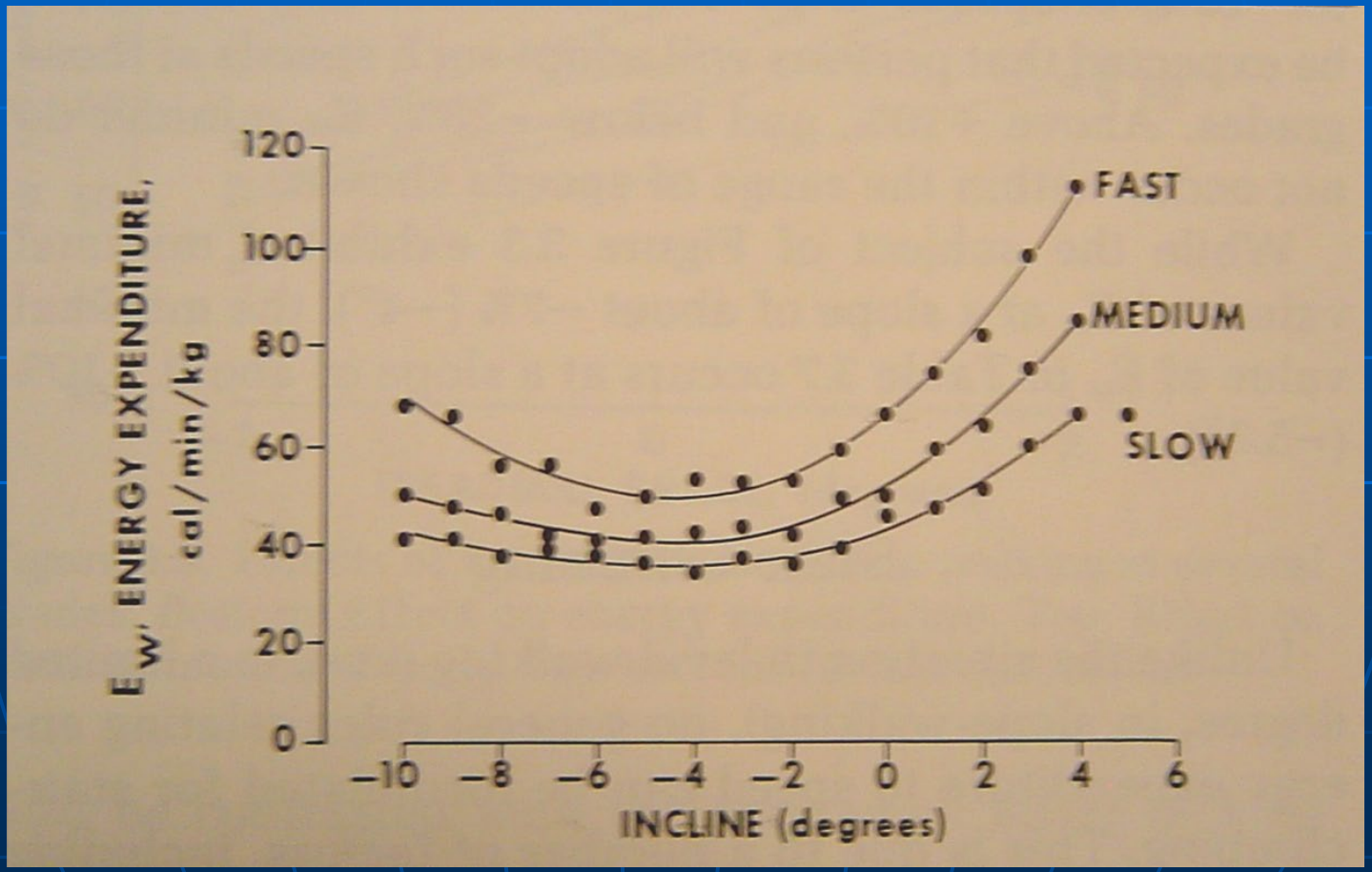
Sinusoidal Motion of the COG



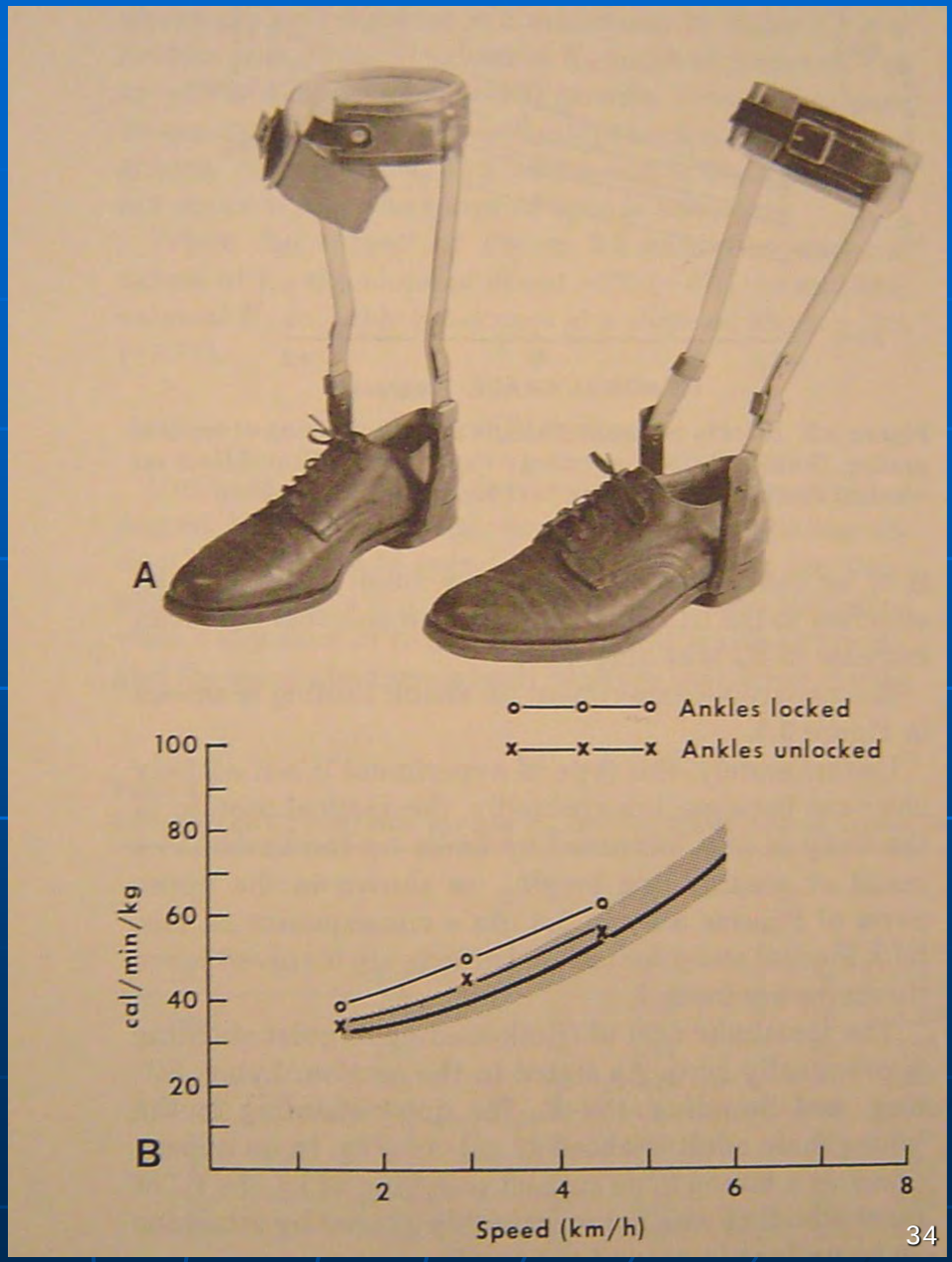
6.Narrow Base of Support to Minimize Horizontal Motion



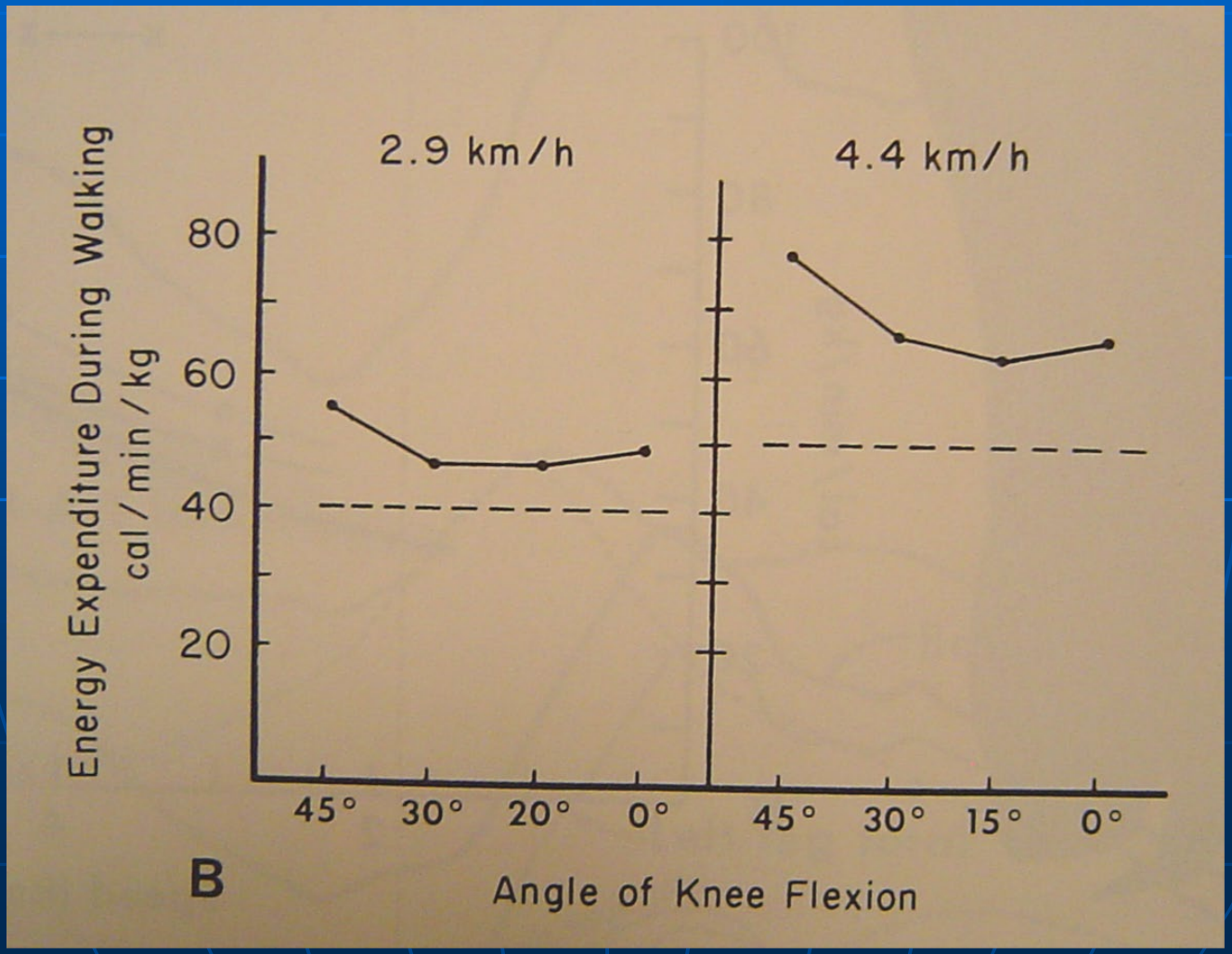
Effect of Incline on Energy



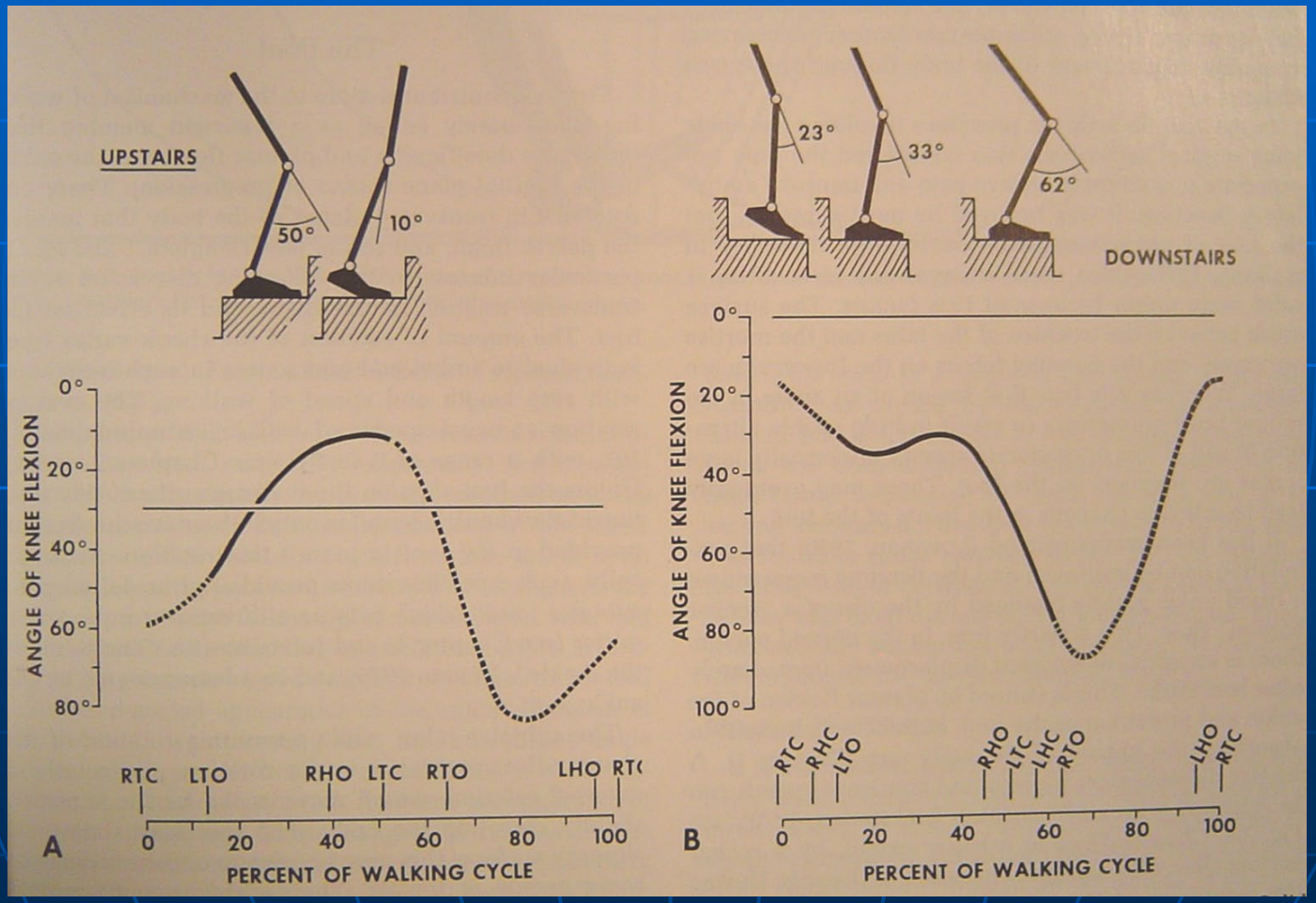
Effect of Ankle Immobilization on Gait



Effect of Knee Immobilization



Up and Down Stairs



Center of Gravity Line

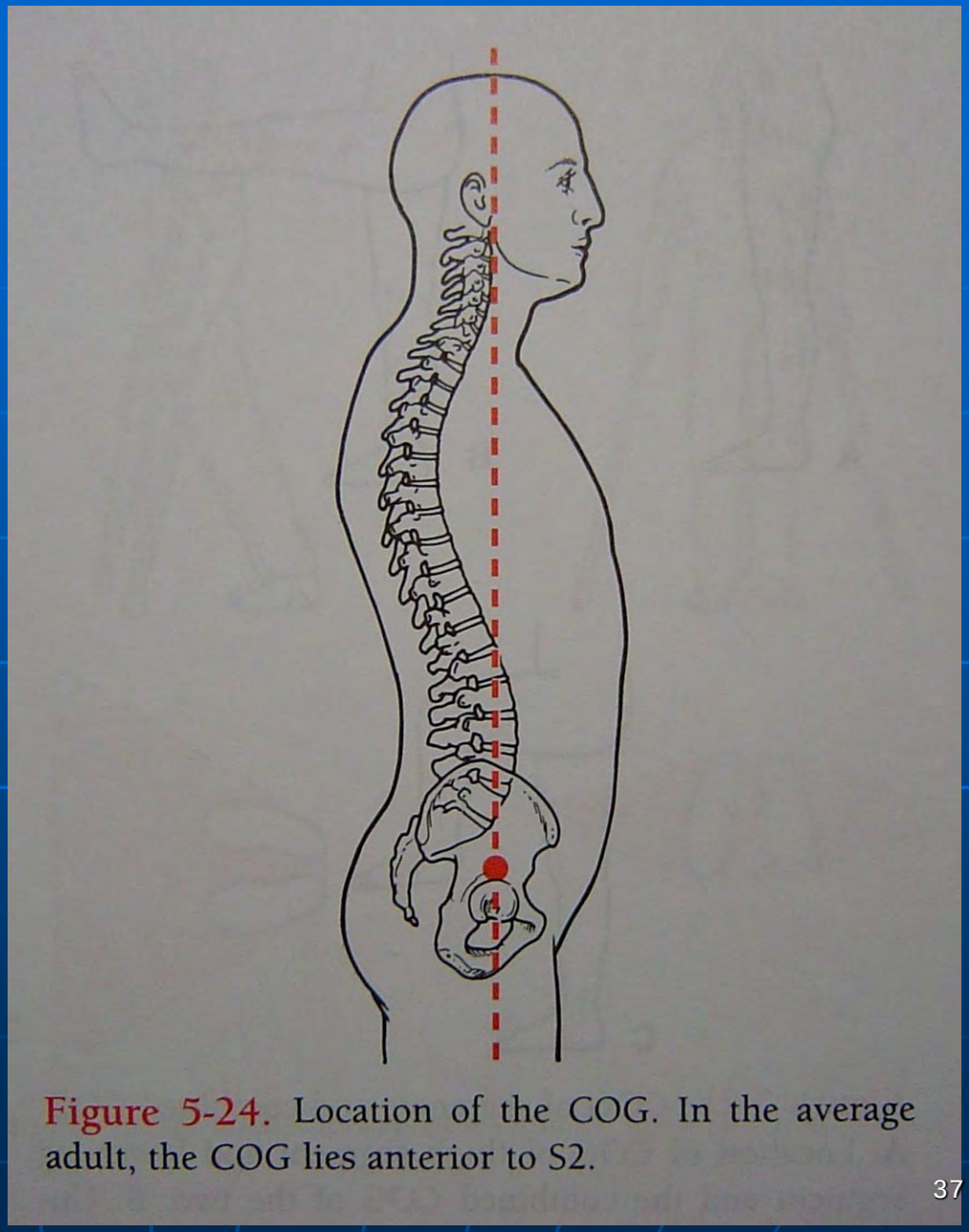


Figure 5-24. Location of the COG. In the average adult, the COG lies anterior to S2.

Base of Support

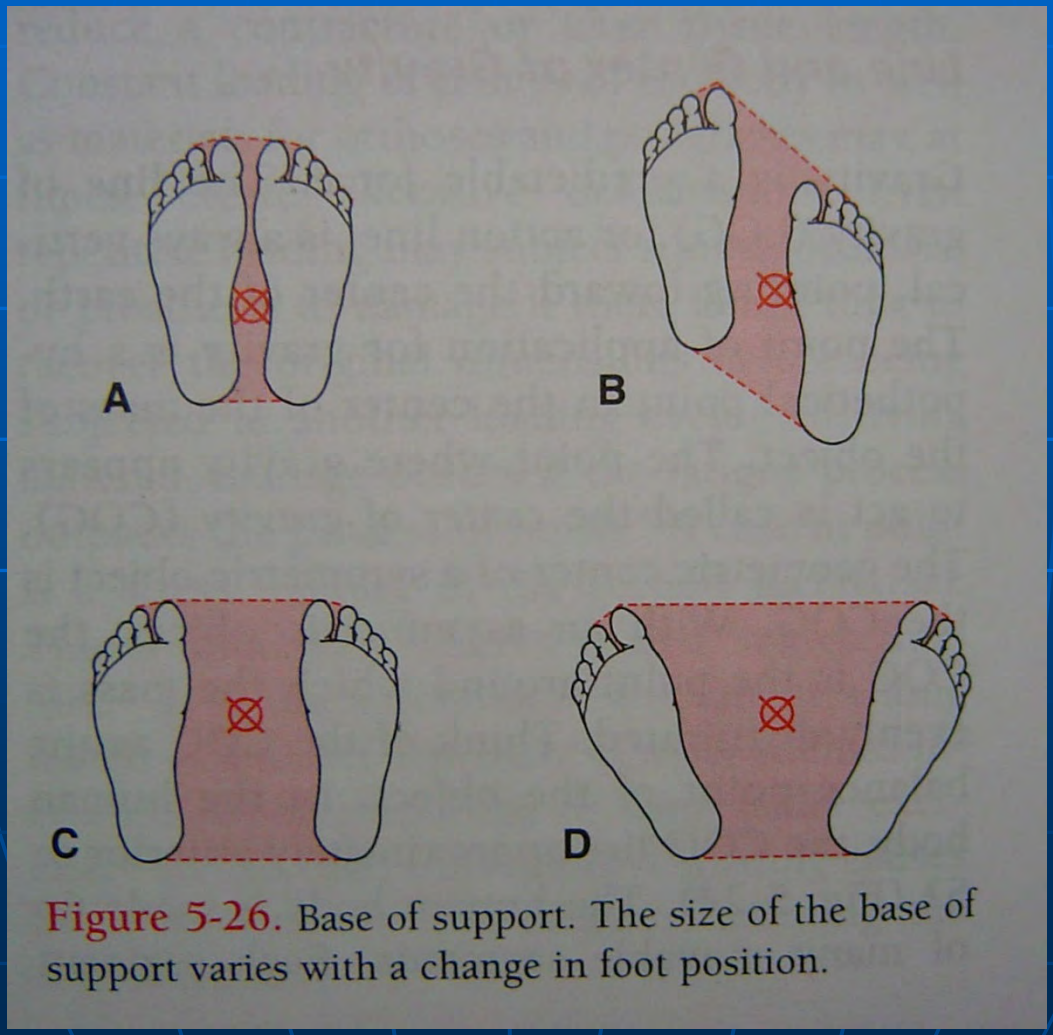


Figure 5-26. Base of support. The size of the base of support varies with a change in foot position.

Base of Support

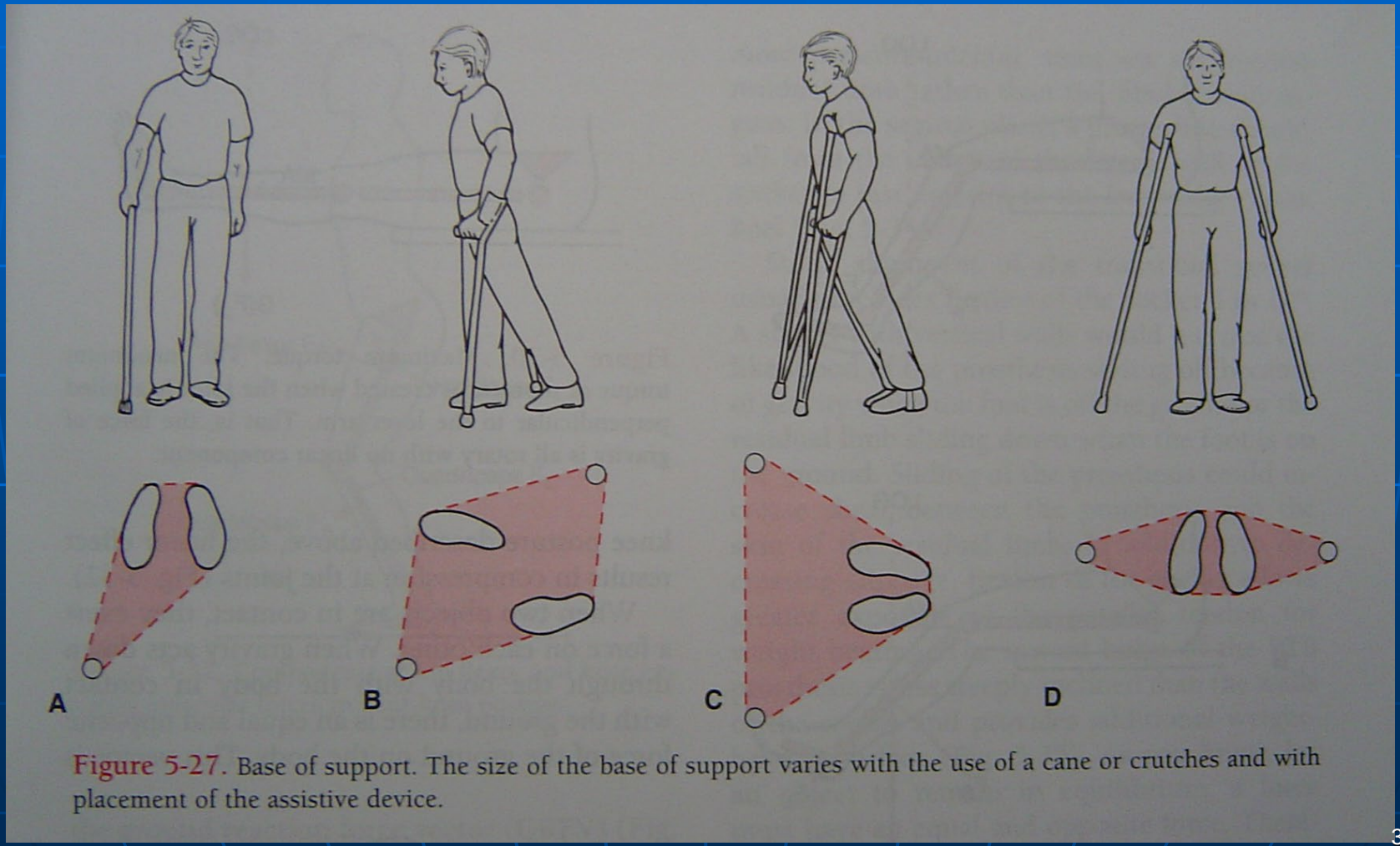


Figure 5-27. Base of support. The size of the base of support varies with the use of a cane or crutches and with placement of the assistive device.

Thank You