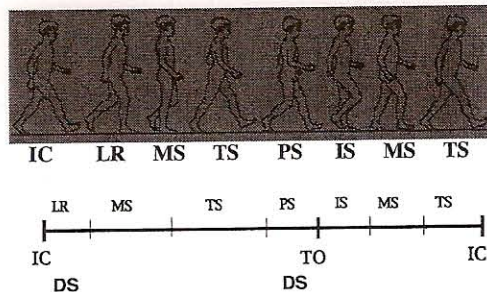


Normal Kinematic Concepts & Patterns

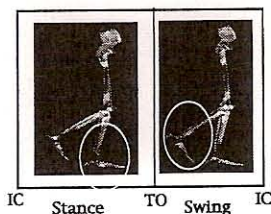
- Tom F. Novacheck, MD
- Director, Center for Gait and Motion Analysis
Gillette Children's Specialty Healthcare
- St. Paul, MN, USA

Gait Cycle -- Walking



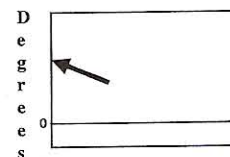
Understanding Kinematic Plots: X axis

- There are no absolute time measures indicated!
- The scale never changes!
 - 0 - 100%
 - IC to IC
 - TO (stance & swing)



Understanding Kinematic Plots: Y axis

- A measure of degrees of movement.
- Sometimes there is a zero line.
- The scale changes for each plot!

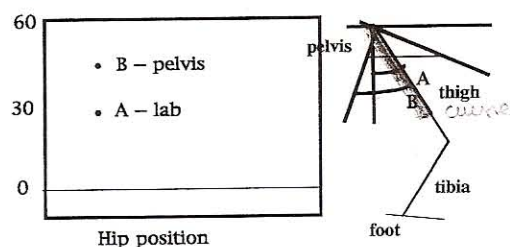


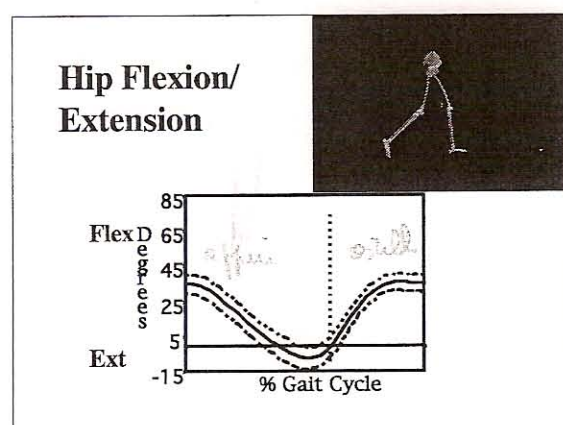
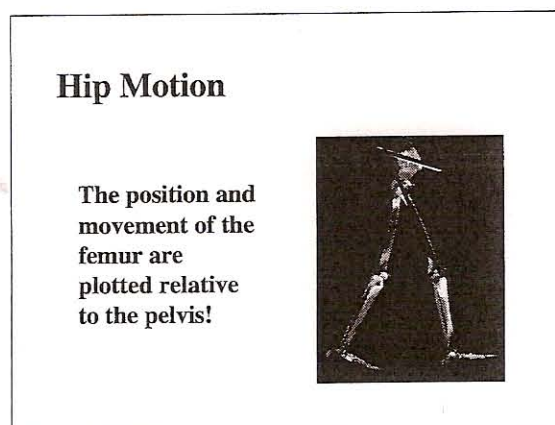
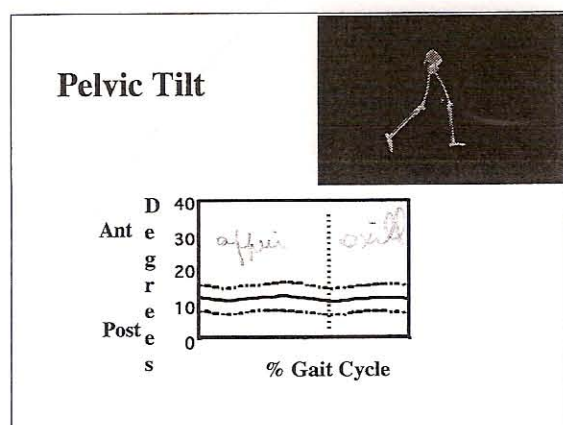
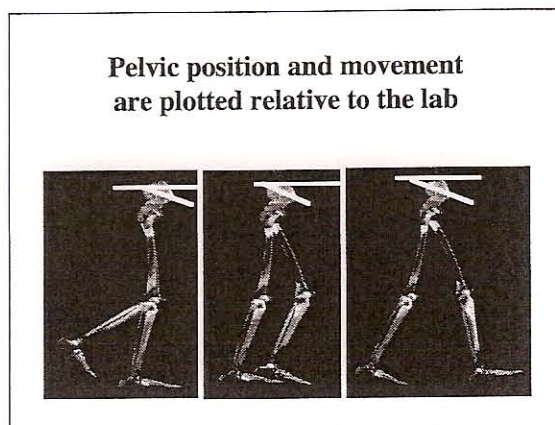
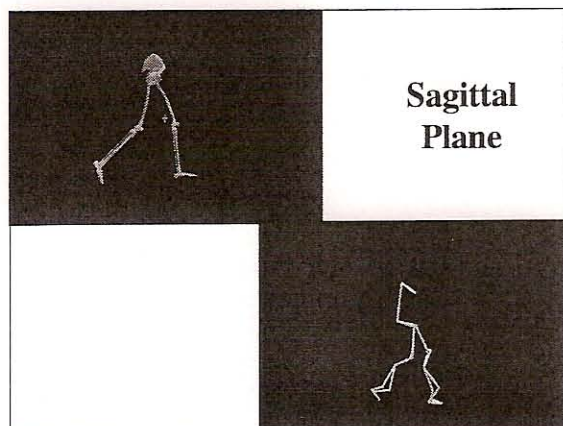
Y axis

- 50 points of data, i.e. every 2% of the gait cycle
- A smooth line connecting those points is drawn.
- The 'picking' of toe-off and initial contact is crucial!

Understanding Kinematic Plots

What is this movement being plotted relative to?





Hip Motion ROM -- 42°

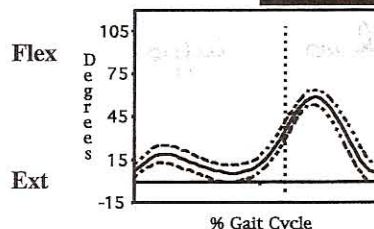
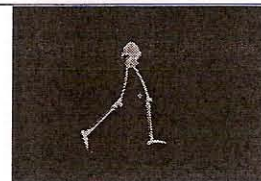
■ Stance	
- LR/MST/TST	-- extension (35° flex to 7° ext)
- PS	-- flexion (7° ext to 0°)
■ Swing	
- ISW/MSW	-- flexion (0° to 35° fl)
- TSW	-- minimal movement

Sagittal Plane Knee Motion

- The tibia is plotted relative to the femur!



Knee Flexion/Extension



Knee Motion ROM -- 55°

■ Stance

- LR -- flexion (8° to 19°)
- MST/TST -- extension (19° to 5°)
- PS -- flexion (5° to 35°)

■ Swing

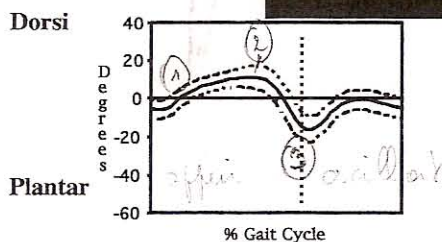
- ISW -- flexion (35° to 60°)
- MSW -- extension (60° to 35°)
- TSW -- extension (35° to 8°)

Sagittal Plane: Ankle Motion

- The foot is plotted relative to the tibia!



Ankle Dorsi/Plantarflexion



Ankle Motion ROM -- 28°

- Stance

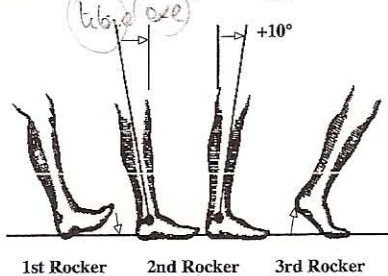
- LR -- plantarflexion (5°pf to 6°pf)
- MST/TST -- dorsiflexion (6°pf to 12°df)
- PS -- plantarflexion (12°df to 7°pf)

- Swing

- ISW -- cont. pl. flexion (7°pf to 16°pf)
- MSW -- dorsiflexion to neutral (16°pf to neutral)
- TSW -- min. pl. flexion (neutral to 5°pf)

① 19 nodes
② 21 nodes
③ 31 nodes

Ankle Rockers (Perry)

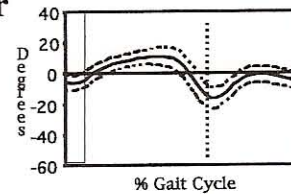


decubitus
anterior

decubitus
anterior
decubitus

decubitus
anterior
decubitus

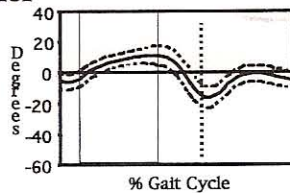
First Rocker



■ Plantarflexion

- Loading Response
- eccentric contraction dorsiflexors
- controlled lowering of the foot to the floor

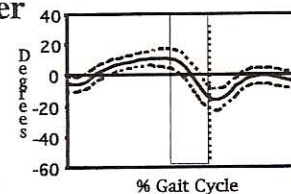
Second Rocker



■ Dorsiflexion

- (MST/TST)
- eccentric contraction plantarflexors
- control of forward motion of the shank over the plantigrade foot

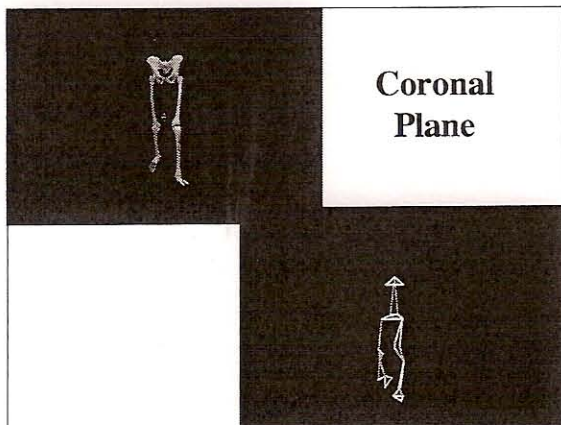
Third Rocker



■ Plantarflexion

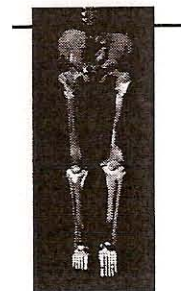
- Preswing
- concentric contraction plantarflexors
- ankle plantarflexion
- push off

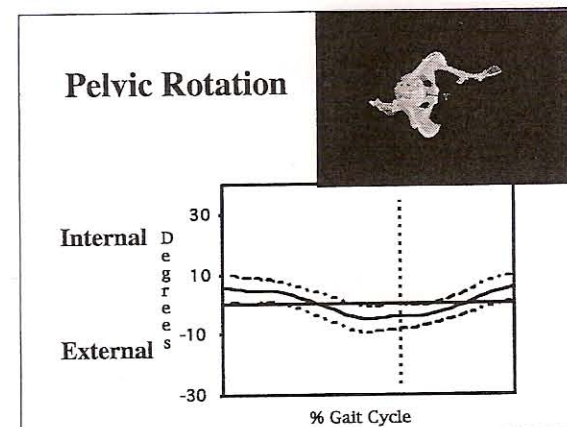
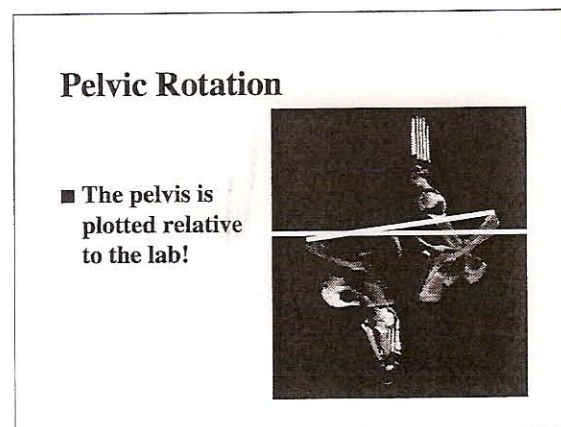
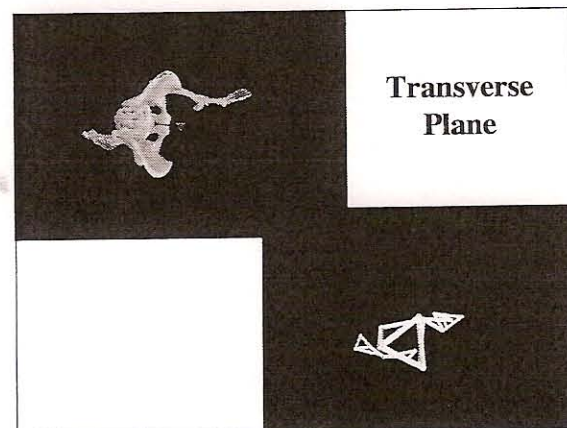
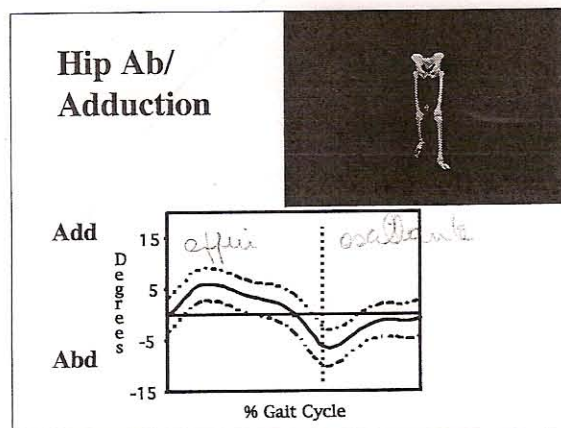
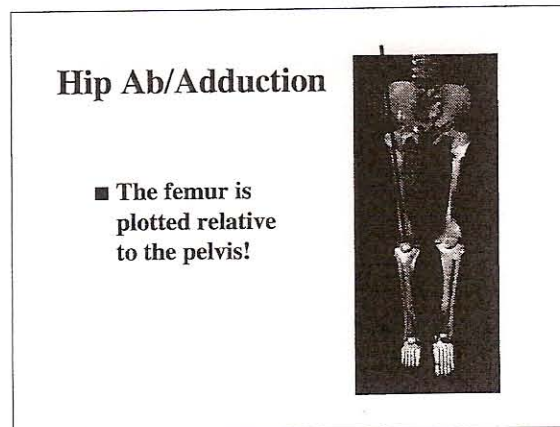
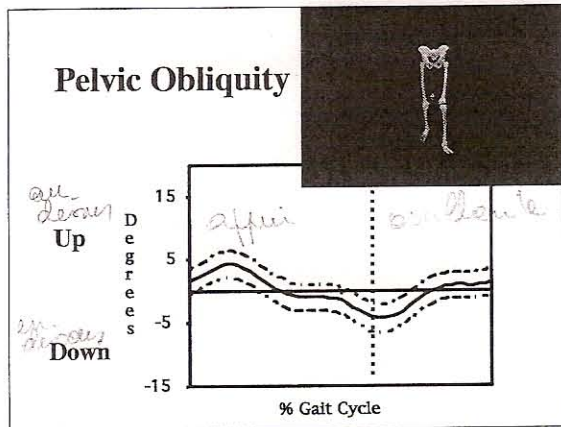
Coronal Plane



Pelvic Obliquity

- The pelvis position and movement are plotted relative to the lab!





Pelvic Motion ROM -- 10°

■ Stance

- LR/MST -- internally rotated 5°
- TST/PS -- ext. rotates 10° to -5°

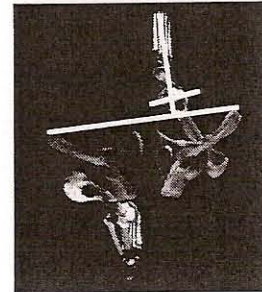
■ Swing

- cont. int. rotation of 10° (from -5° to 5°)

■ Neutral position twice in the gait cycle

Hip Rotation

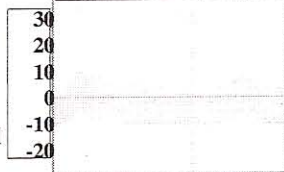
- The hip (as reflected by the distal femoral condyles) is plotted relative to the pelvis!



Hip Rotation

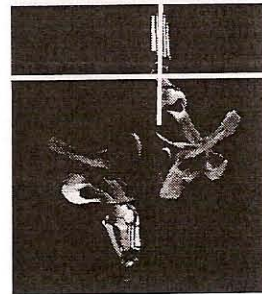
Internal

External



Foot Progression

- The foot is plotted relative to the lab!



Foot Progression

Internal

External

