Introduction to Human Walking & Clinical Gait Analysis

Jessica Rose, Ph.D.

Associate Professor, Department of Orthopaedic Surgery
Stanford University School of Medicine

Motion & Gait Analysis Lab
Lucile Packard Children's Hospital

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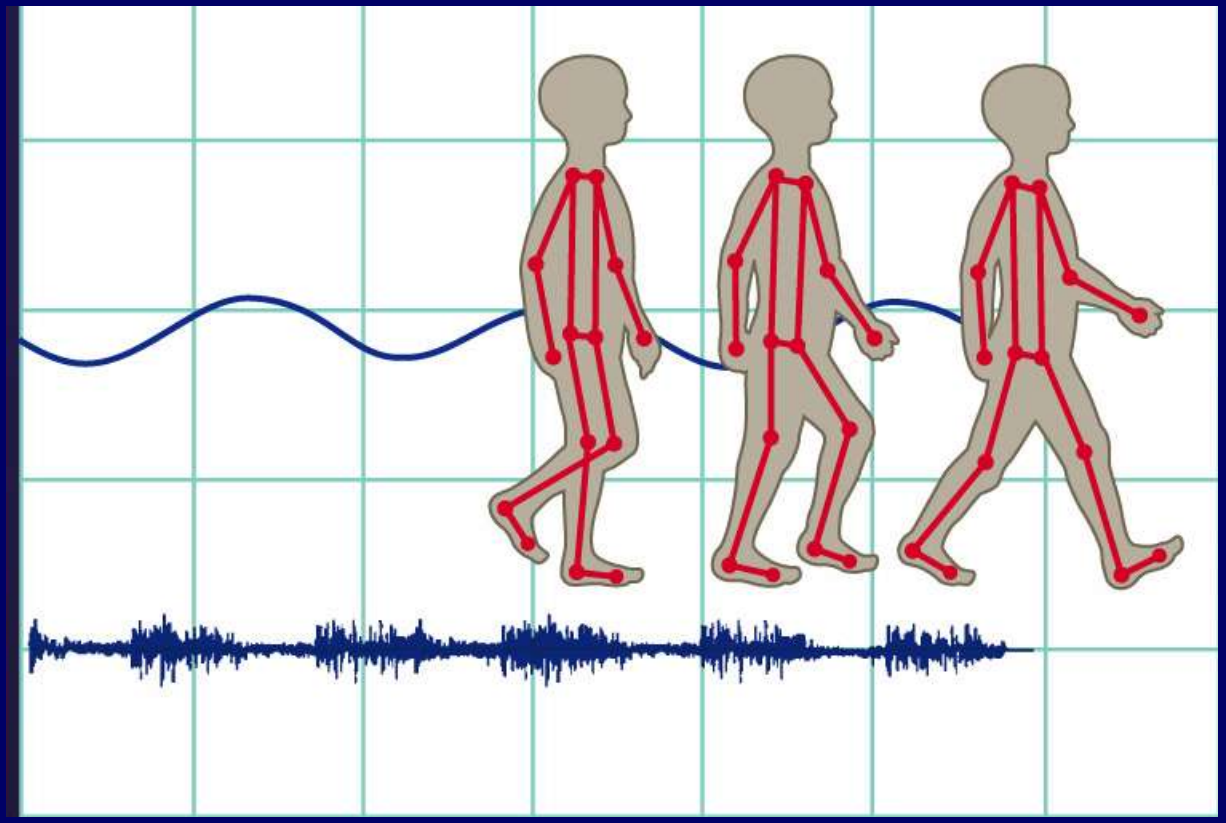
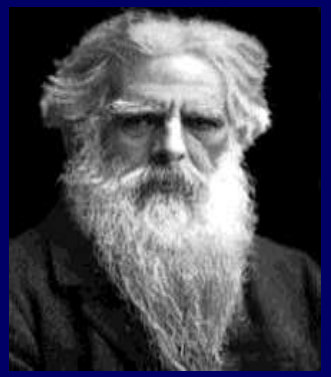
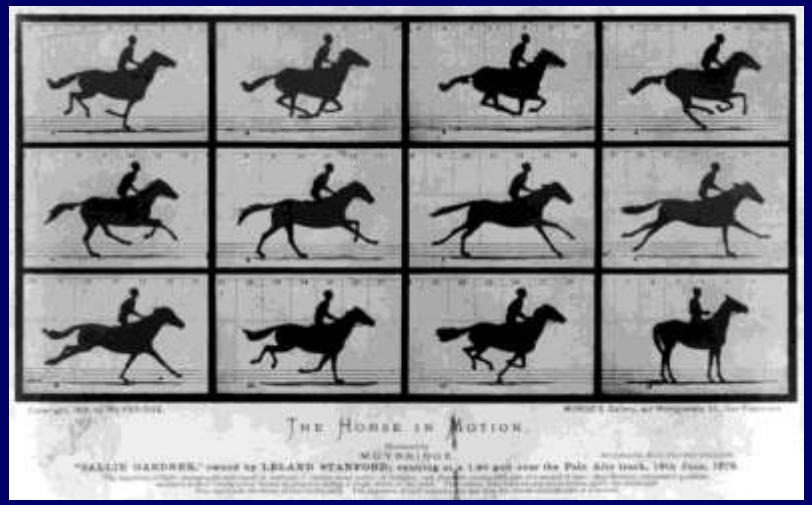
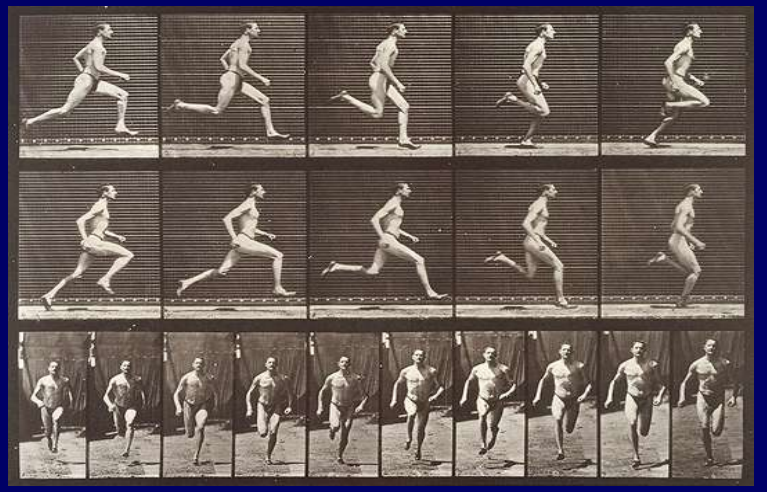


Motion Analysis at Stanford

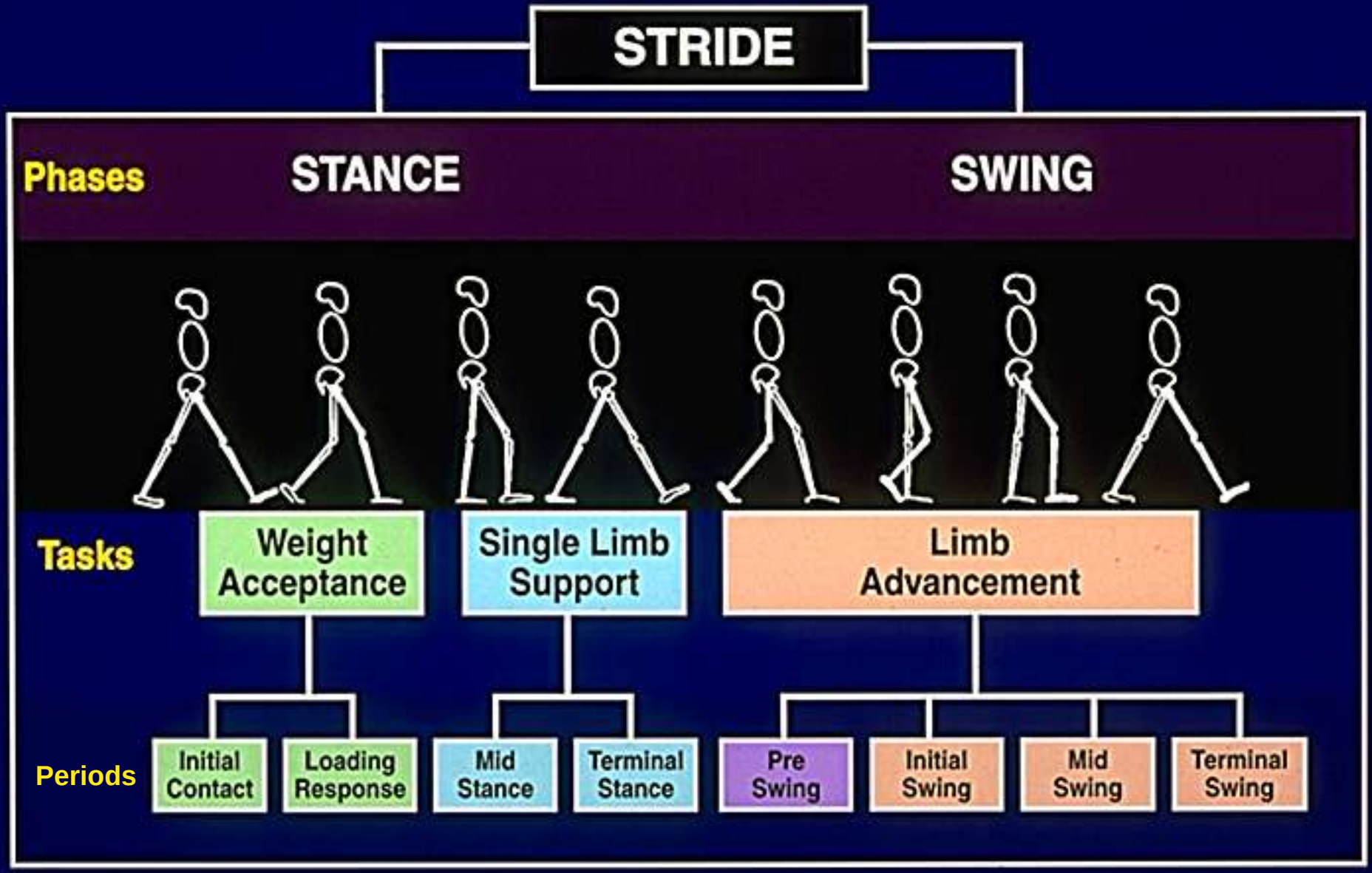
Edweard Muybridge & Leland Stanford 1878



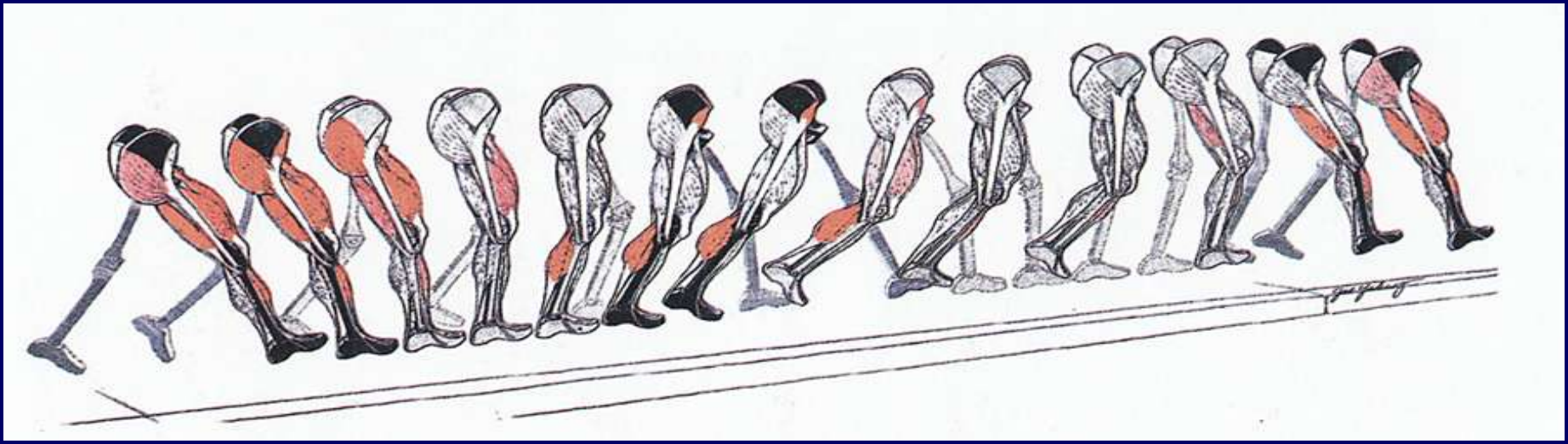




The Gait Cycle



Muscle Activity During Gait



Gait Analysis

- Video
- Kinematics and Kinetics
- Dynamic EMG
- Postural Balance
- Energy Expenditure

Kinematics & Kinetics

- Kinematics: 3-D Joint Motion

  8 Digital Motion Capture Cameras Record

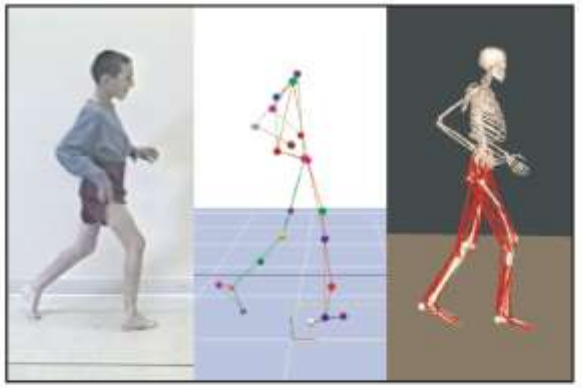
  Position of Light Reflective Markers

- Kinetics: Forces Passing Through the Joints

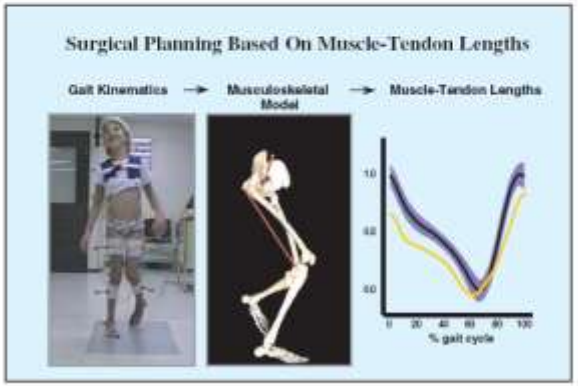
  Force Plate Embedded in the Floor Records

  Ground Reaction Force Vectors

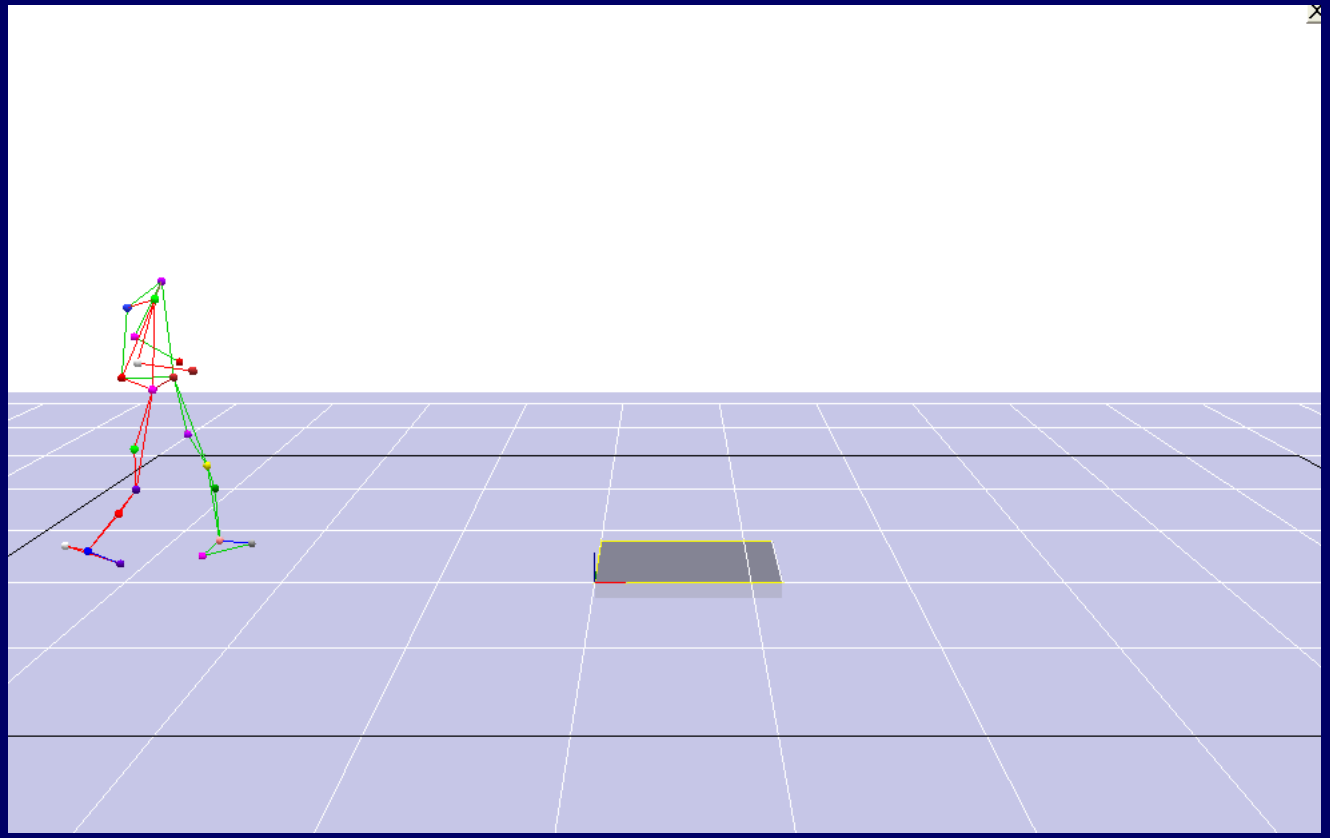
Musculoskeletal Computer Models of Gait



Computer models are generated from gait kinematics (joint motion) and kinetics (joint forces) and reveal the biomechanical features that influence gait.



The changing muscle lengths during gait are calculated using the computer model. Muscles that are too short and limit gait can be identified and selected for treatment.

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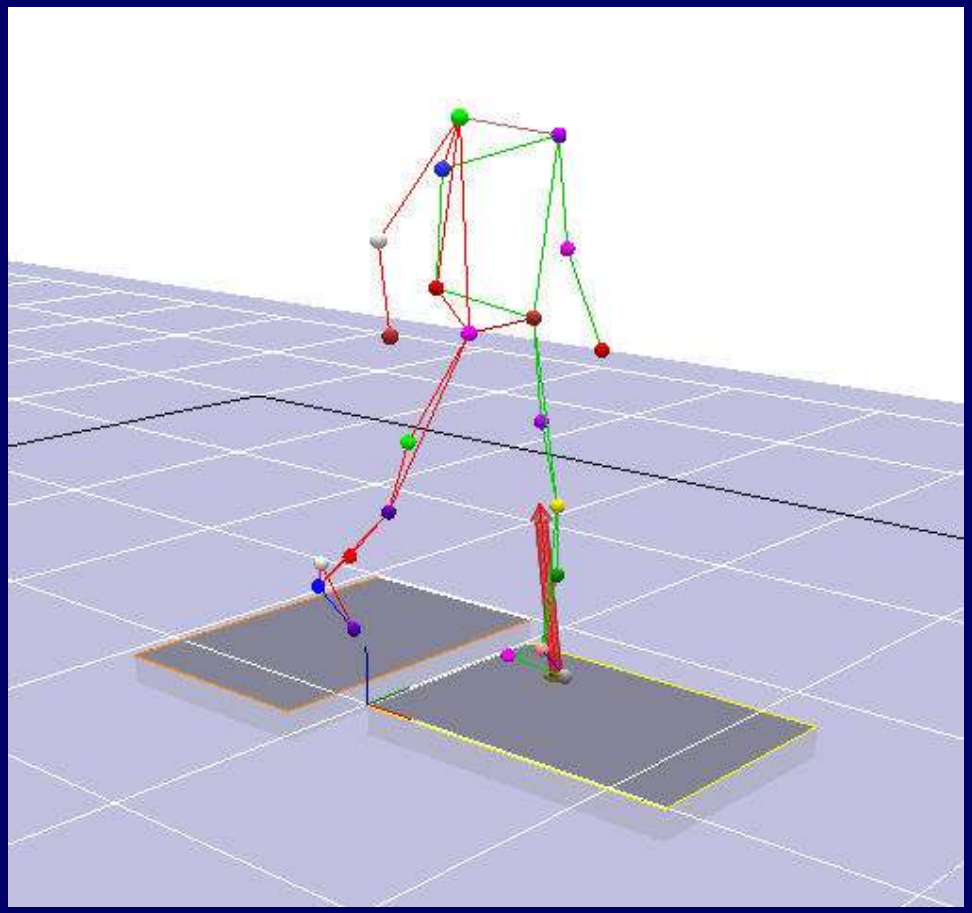
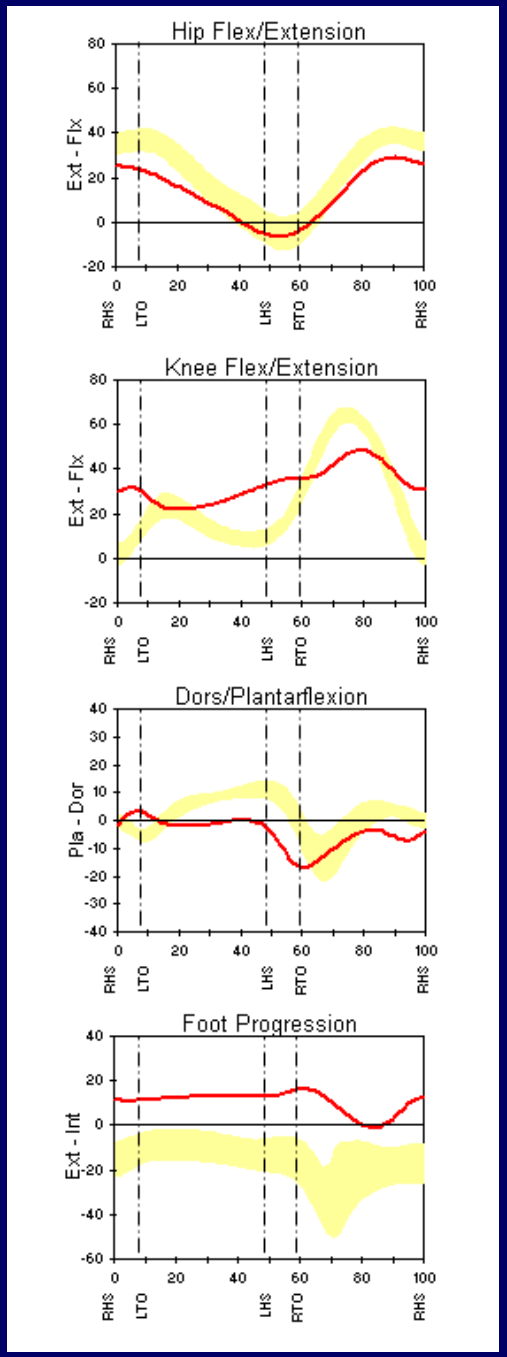
Kinematics & Kinetics



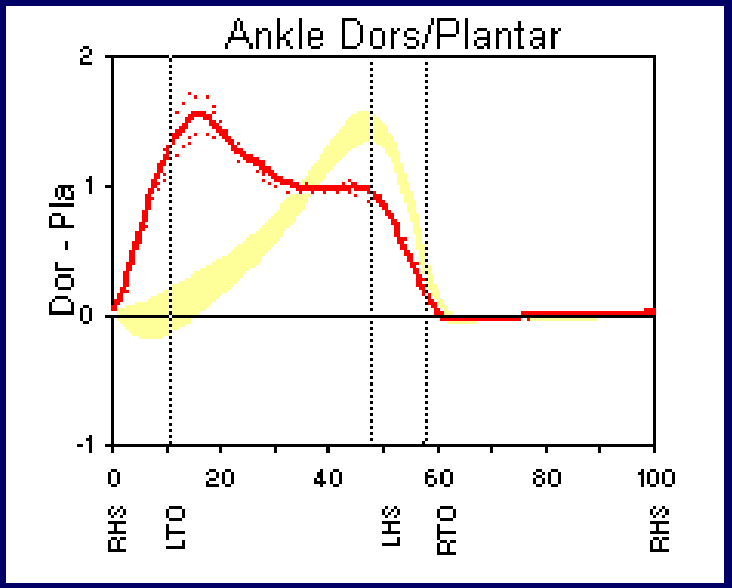
Kinematics

- Nearly normal hip motion
- Increased knee flexion at IC and stance
- Reduced peak knee flexion in swing
- Increased plantar flexion in terminal stance
- Internally rotated foot progression



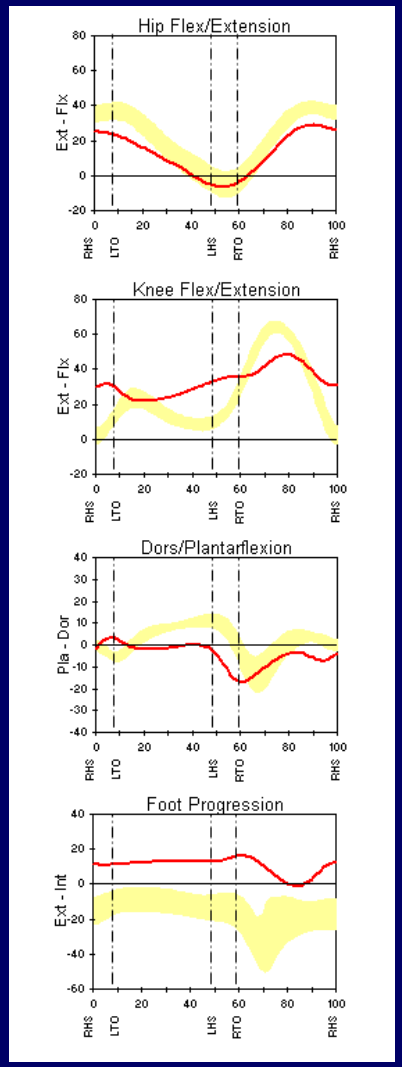
Kinetics

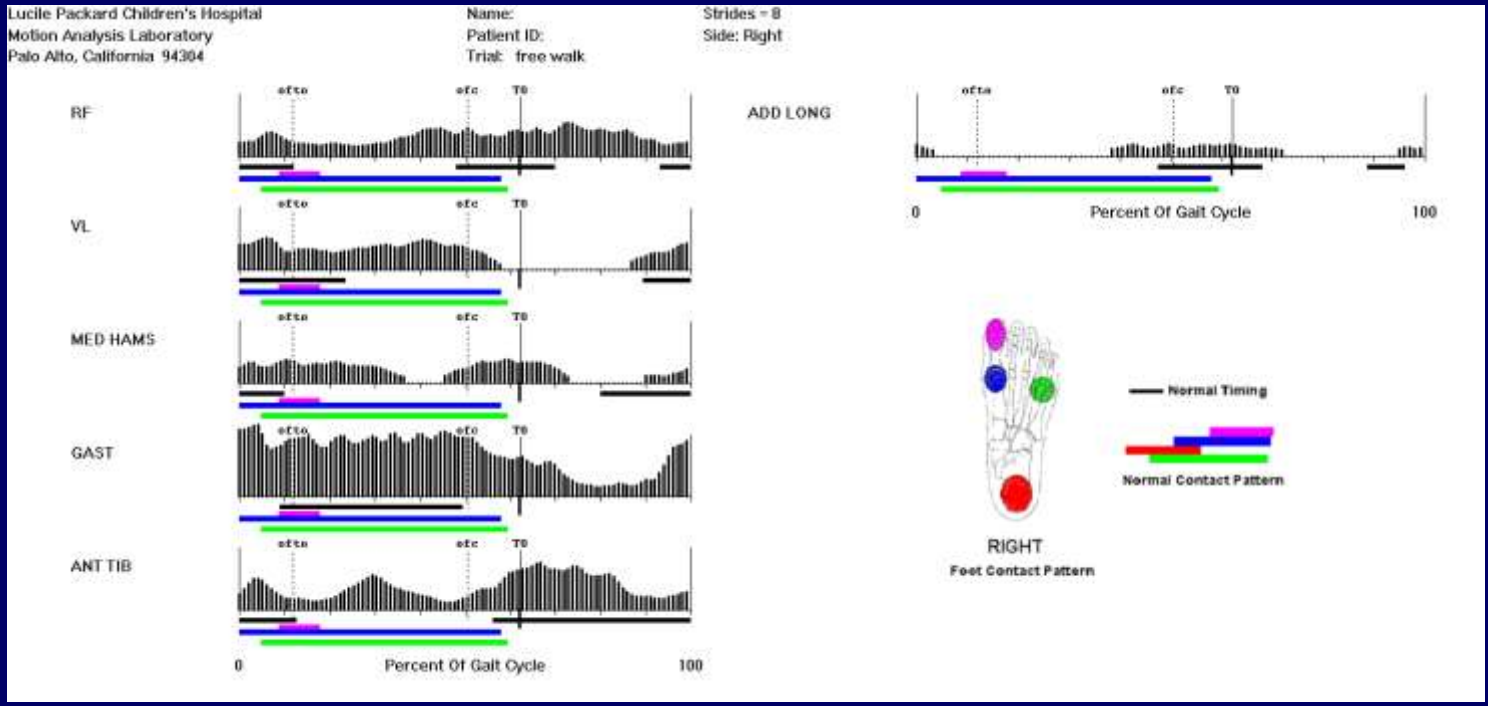
- Toe Walking “Double-Bump” Ankle Plantarflexor Moment Pattern
- Increased plantar flexor moment in loading response associated with increased plantar flexion at IC
- Decreased moment in terminal stance associated with a reduced forefoot rocker



Dynamic EMG & Kinematics

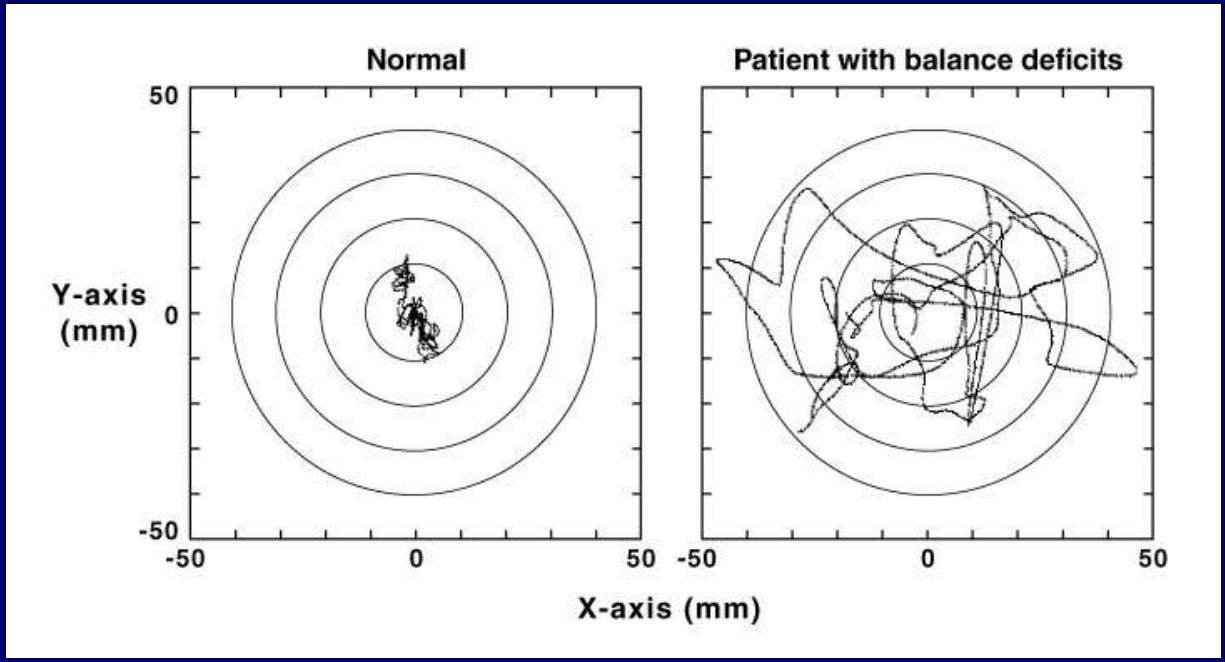
Equinus Gait



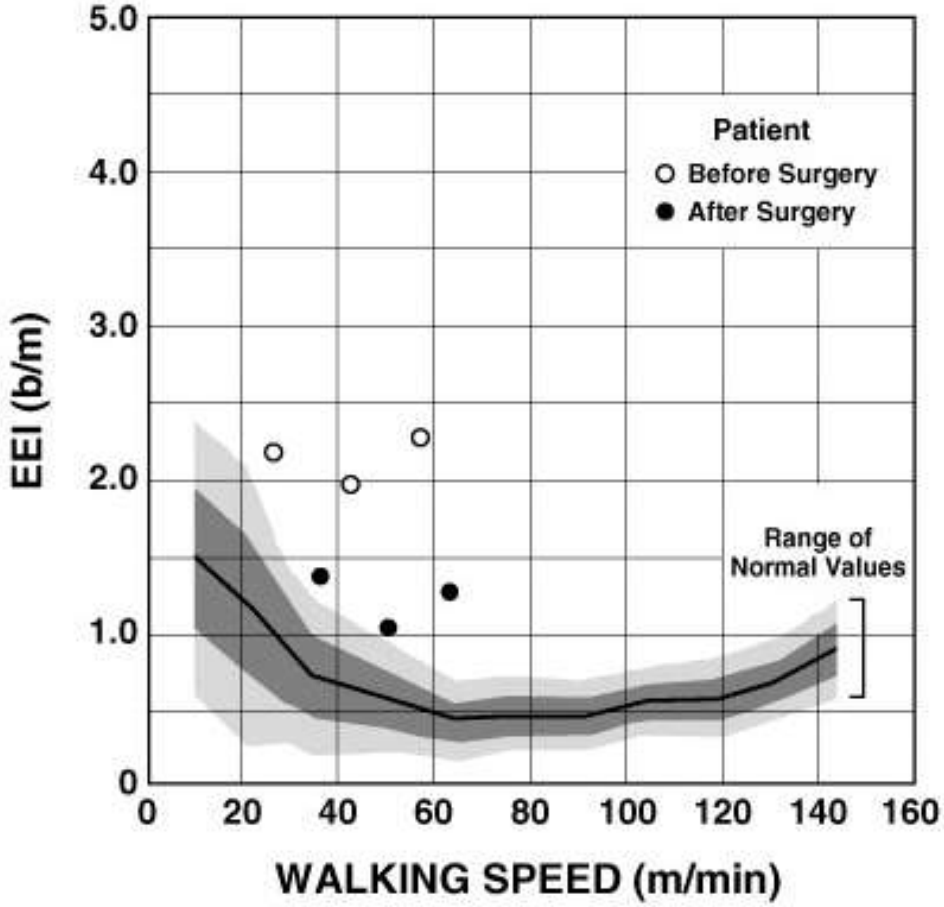


Postural Balance

- Force Plate Center of Pressure
- Postural Sway with Eyes Open / Closed



Energy Expenditure Index



$$EEI = \frac{\text{Walking Heart Rate} - \text{Resting Heart Rate}}{\text{Walking Speed}}$$

Pathologic Gait

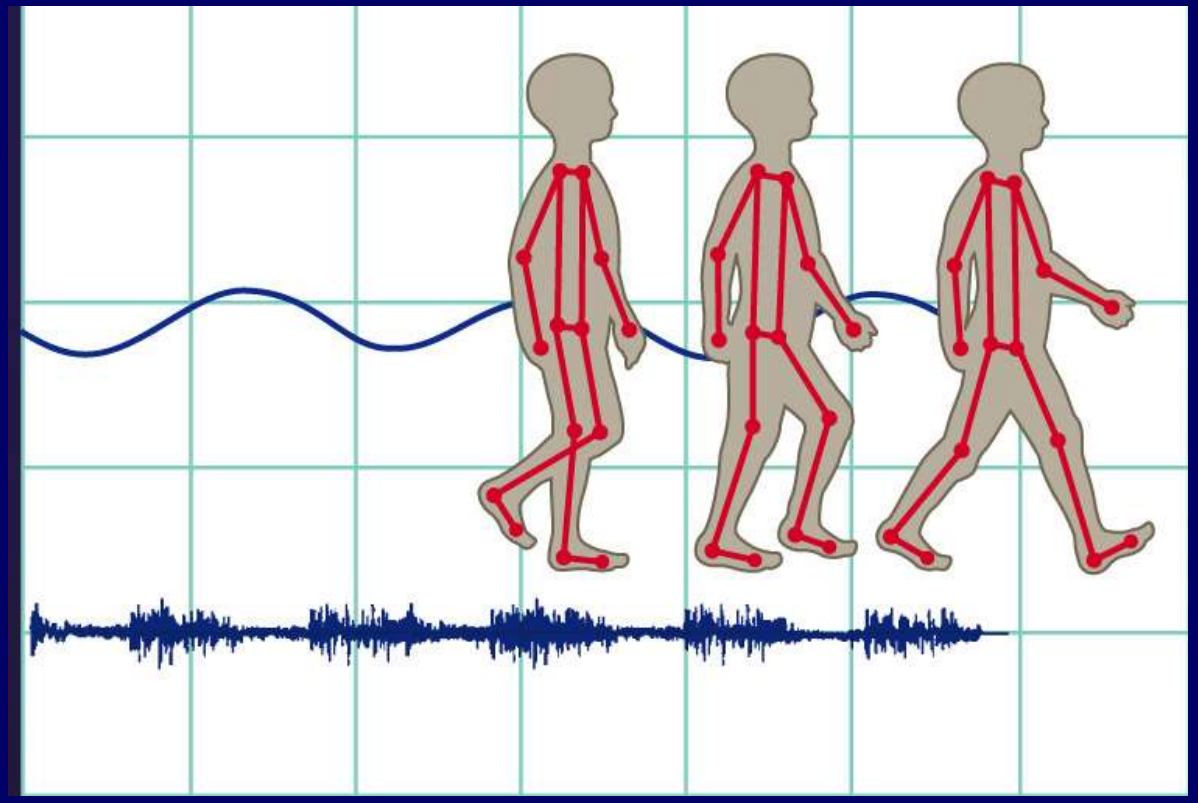
Neuromuscular Conditions

Cerebral Palsy, Stroke, Traumatic Head Injury

- Equinus
- Equinovarus
- Pseudo equinus (knees bent, ankles at neutral, forefoot contact)
- Jumped (knees bent, ankles true equinus)
- Crouch (knees bent, ankles dorsiflexed)
- Stiff–knee gait

Motion & Gait Analysis Lab

Research



Thank You