

# The Use of Specks in Gait Analysis

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# Gait Analysis

- Brief observation to sophisticated measurement
- Patient population
  - 75% paediatric
  - Cerebral Palsy
  - Neurological Disorders
  - Prosthetics
- Treatment Planning
- Analysis of intervention

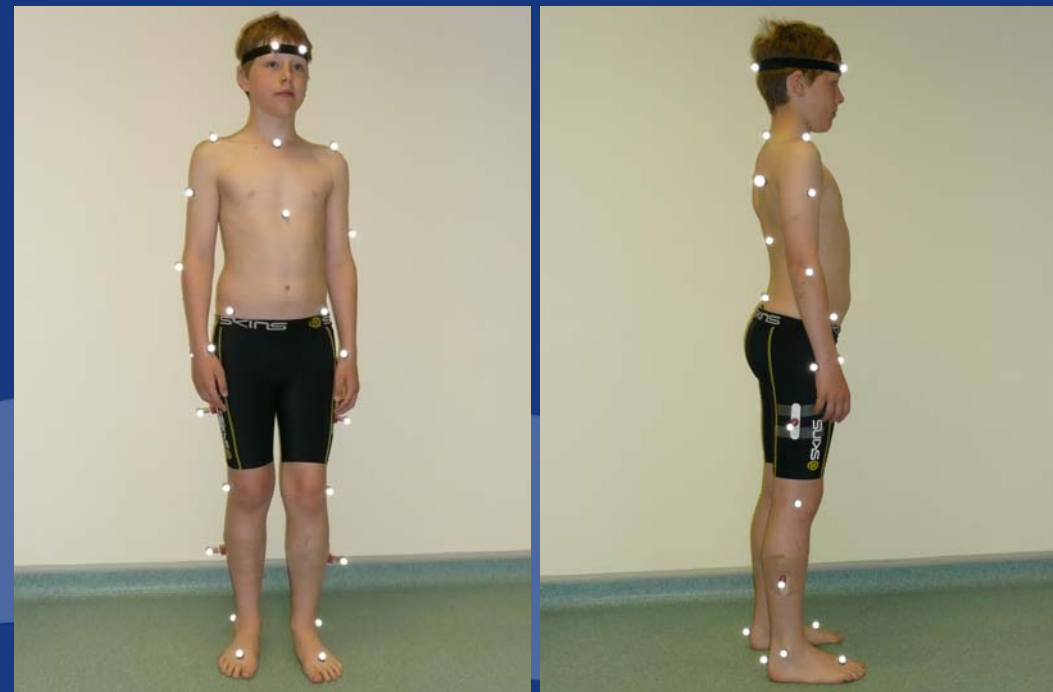
# Clinical Gait Analysis

- One of 2 centres in Scotland providing clinical gait analysis
- Clinical Gait Analysis – 3D analysis
- Vicon 460



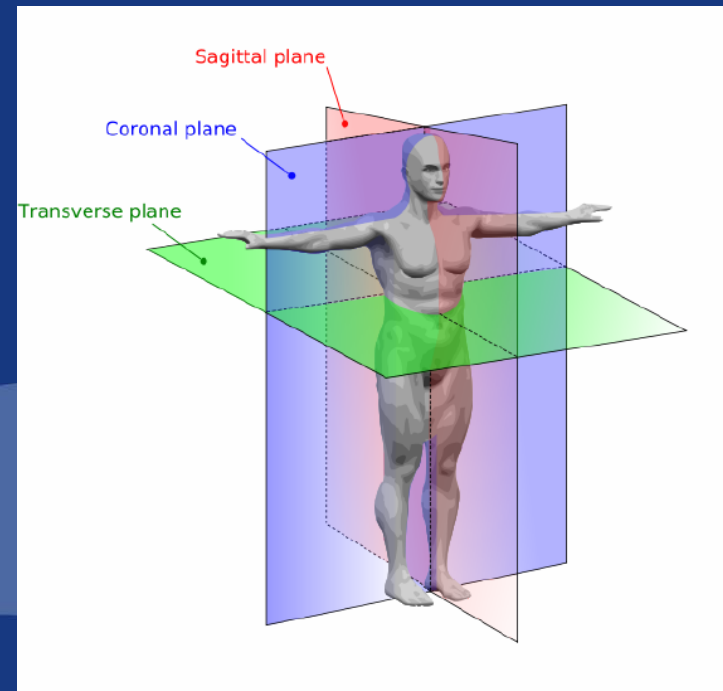
# Biomechanical model

- Three markers per body segment
- Markers on joints define two adjacent segments
- Marker placement conducted by physiotherapist
- Markers placed on bony prominences and anatomical markers

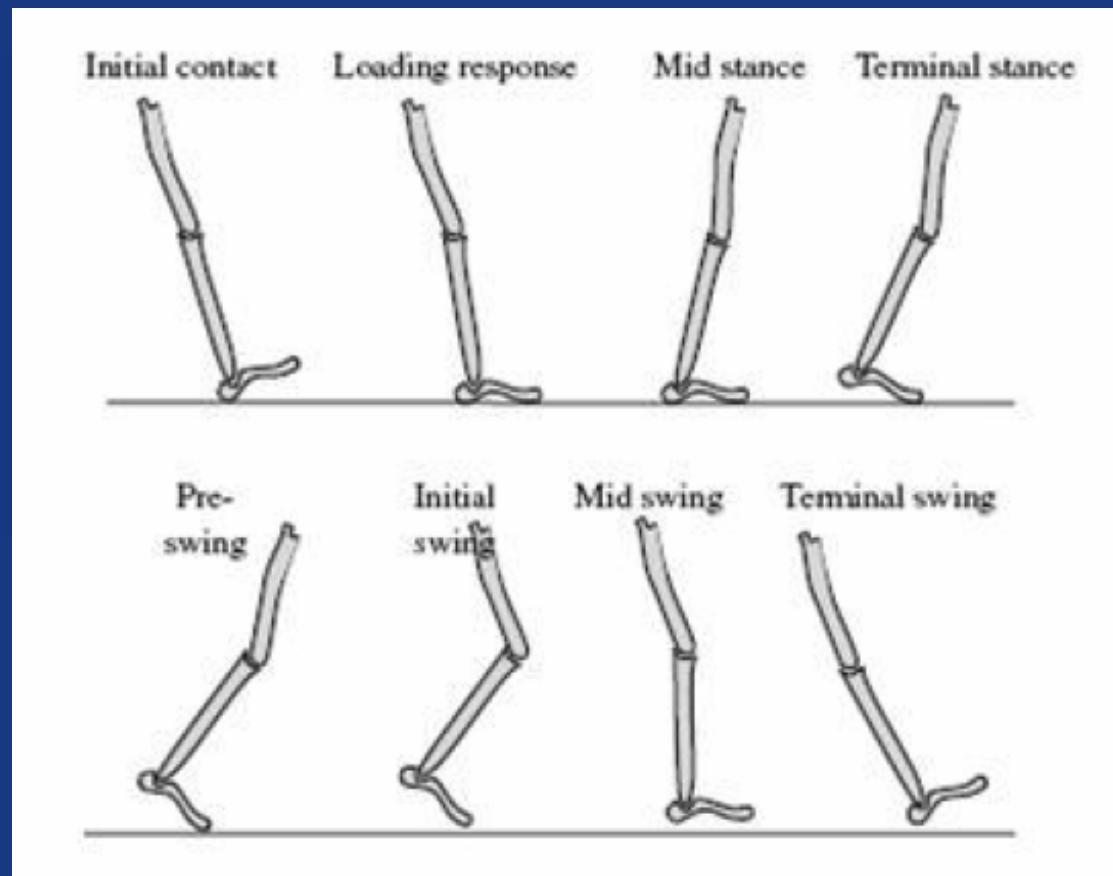


# Biomechanical model

- Modified Helen Hayes model 3D axis system for each segment
  - Sagittal plane angles - Flexion/extension
  - Coronal plane angles Abduction/adduction
  - Transverse plane angles Internal/external rotation



# Phases of Gait

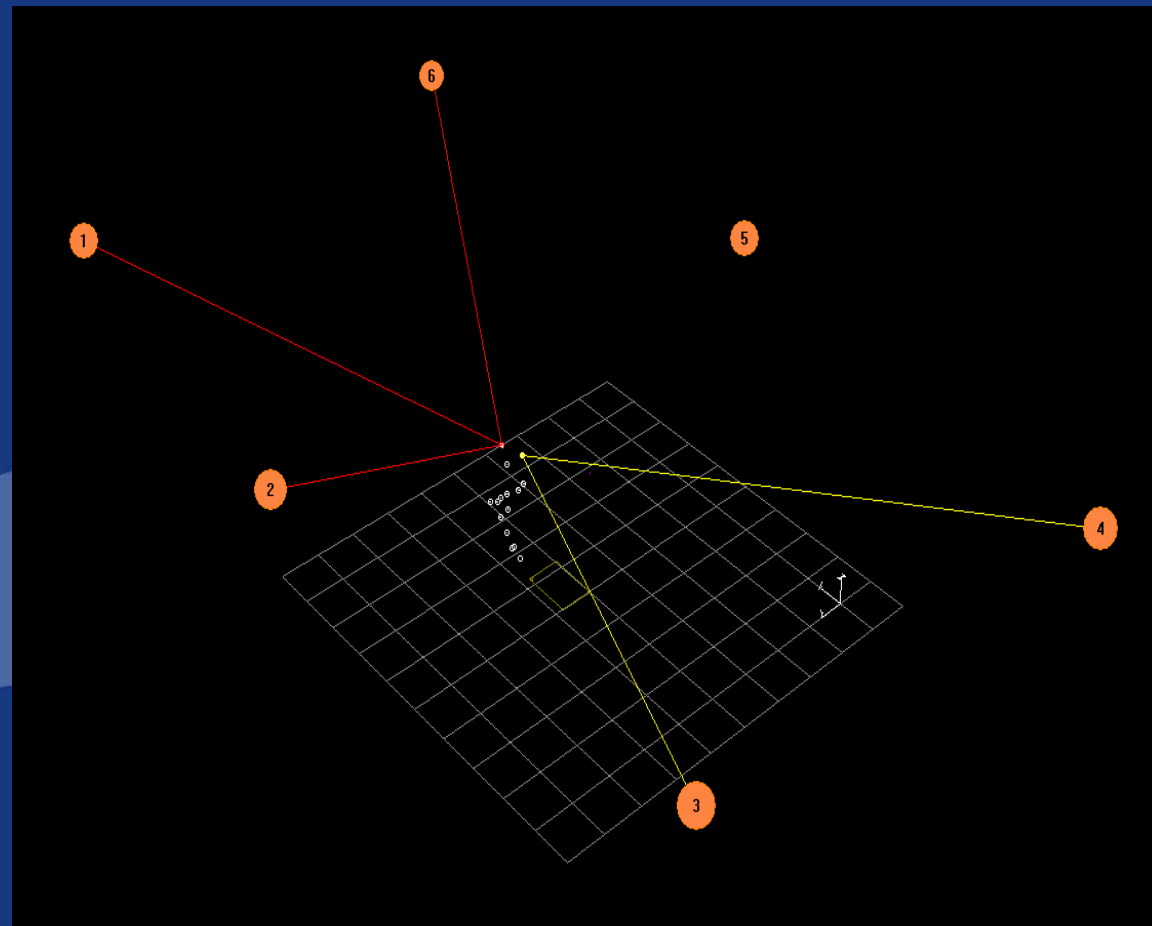


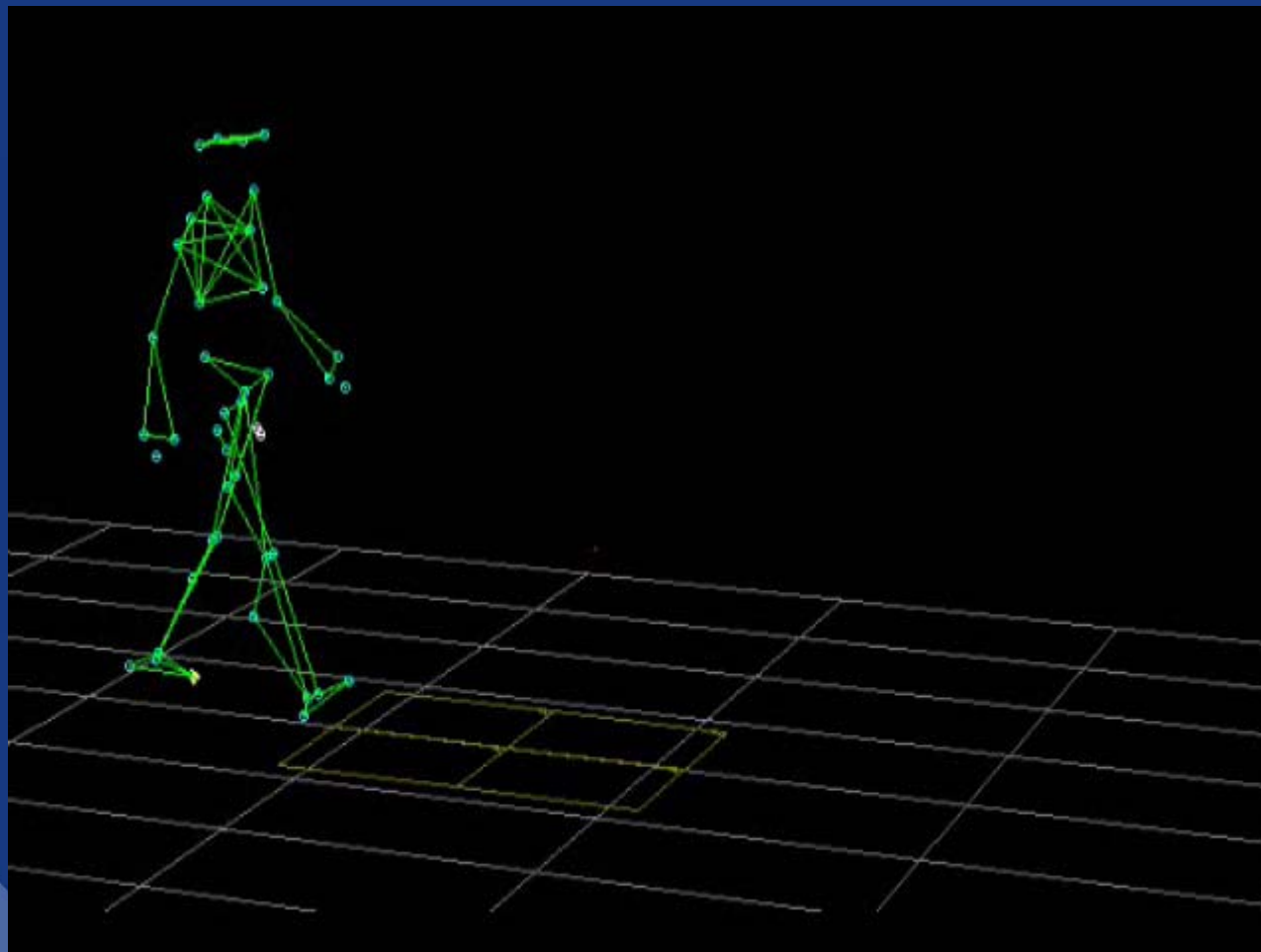
# Clinical Gait Analysis

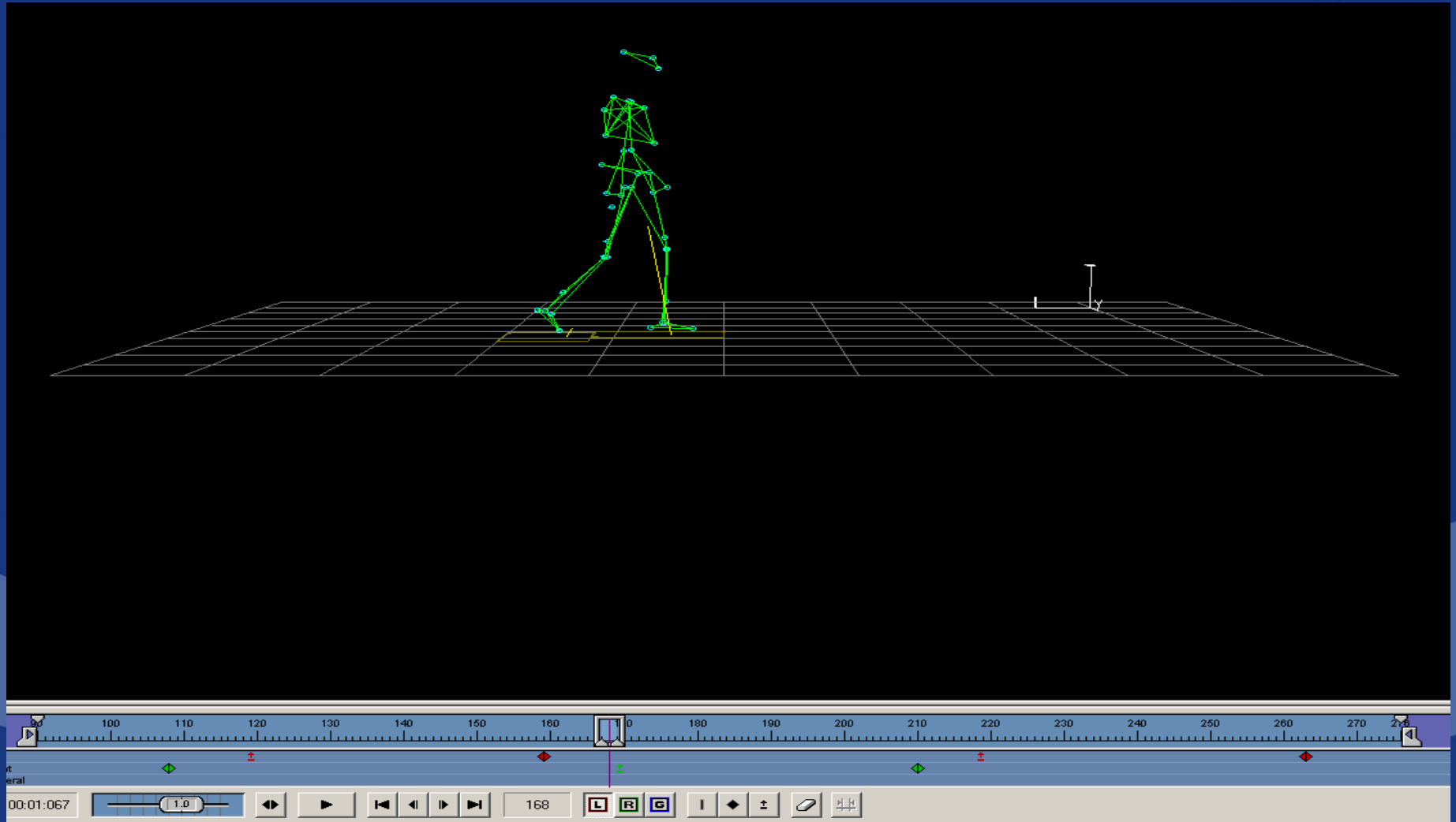


# Three-dimensional gait analysis

- Track images from two or more cameras
- Points used to reconstruct original 3D trajectories



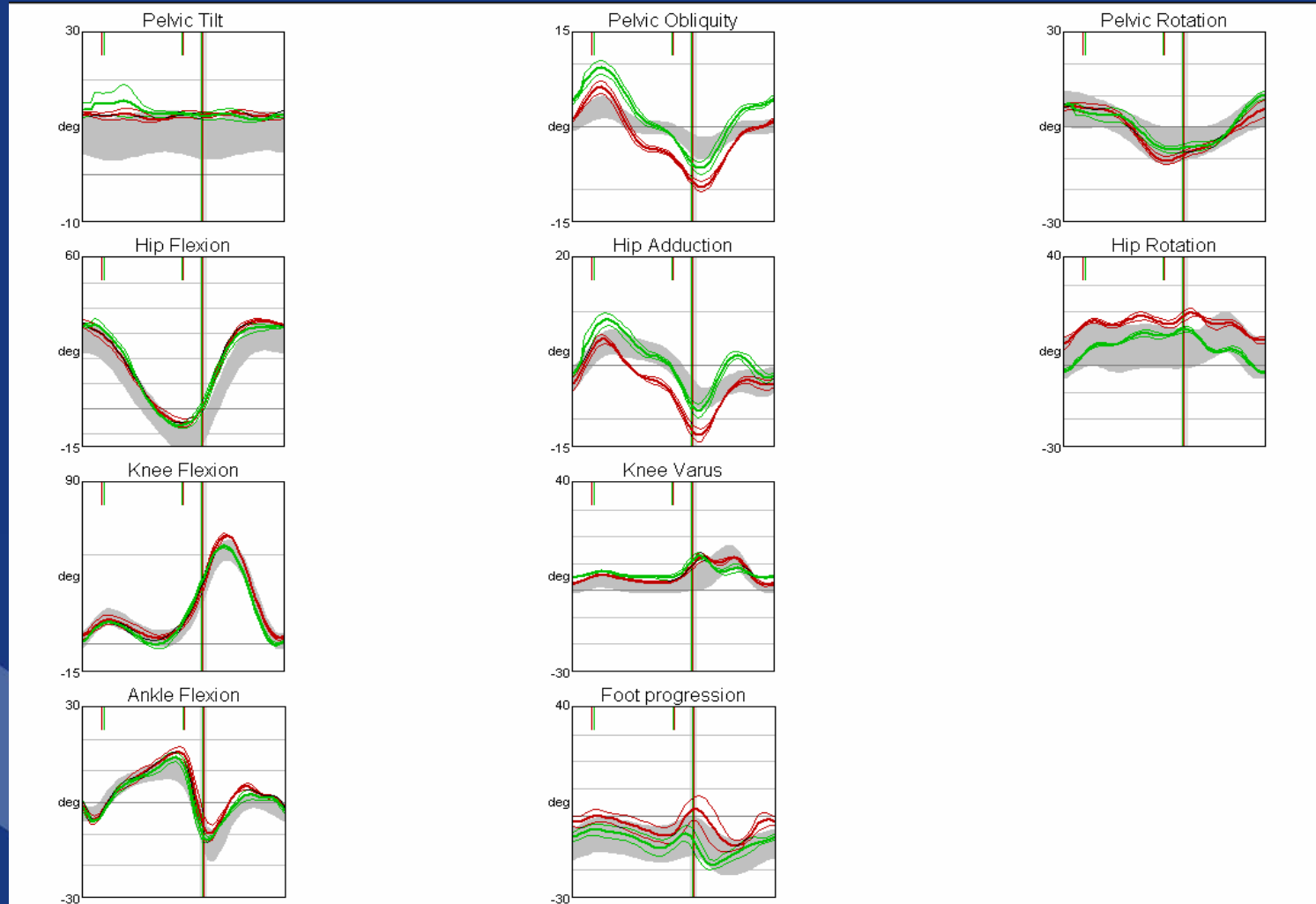




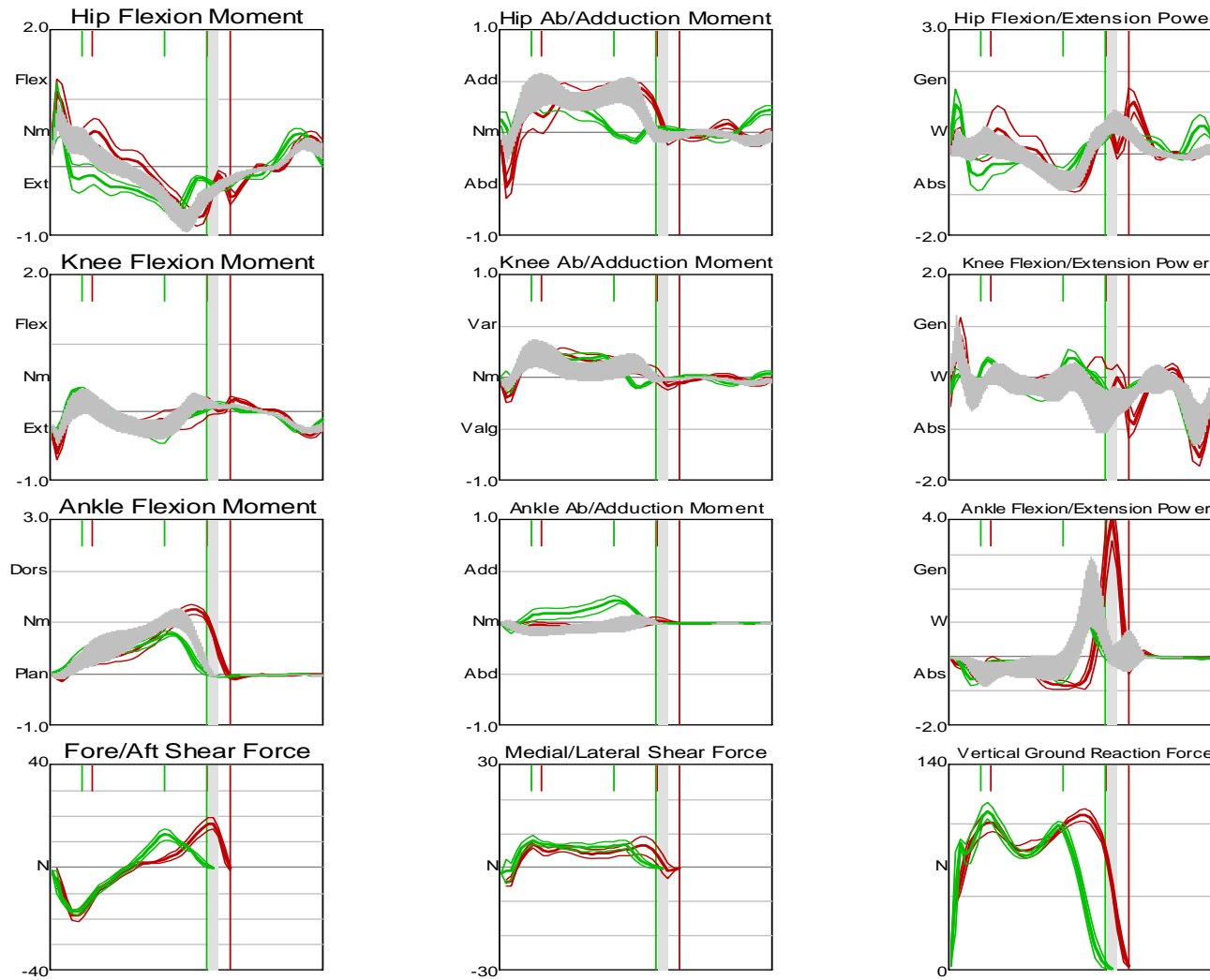
# Clinical Gait Analysis

- Kinematics
  - Angular displacements in 3 planes
- Kinetics
  - Forces, moments, powers
- Temporal Parameters
  - Walking speed (m/s)
  - Cadence (steps/min)
  - Double/Single support time (s)
  - Stride length (m)
  - Step length (m)
  - Step time (s)

# Kinematics



# Kinetics



Left Mean Barefoot (Mean Barefoot)

Right Mean Barefoot (Mean Barefoot)

Avg File 7 (Normals.gcd)

# Limitations of current methods of Clinical Gait Analysis

- Modelling errors
  - Centre of knee rotation
  - Marker placement
  - Soft tissue movement
  - Foot modelling

# Limitations of current methods of Clinical Gait Analysis

- Practical data collection constraints
  - Artificial capture environment
  - Snapshot analysis
  - Restricted activities
  - Specialist staff
  - Intrusive
  - Expensive

# Specks



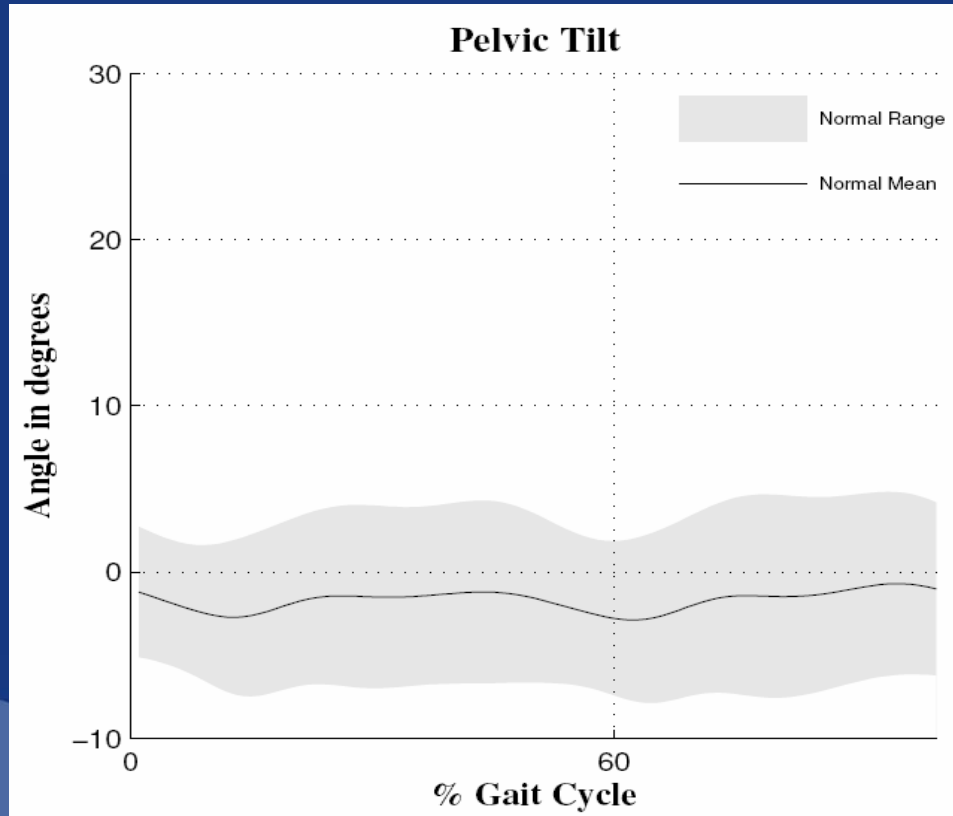
## Potential benefits of Specks for CGA

- Address limitations of current optical motion capture methods
- Provide objective measure of functional ability in every day environments
- Provide ongoing monitoring
- Increase national service capacity
- Reduce assessment costs

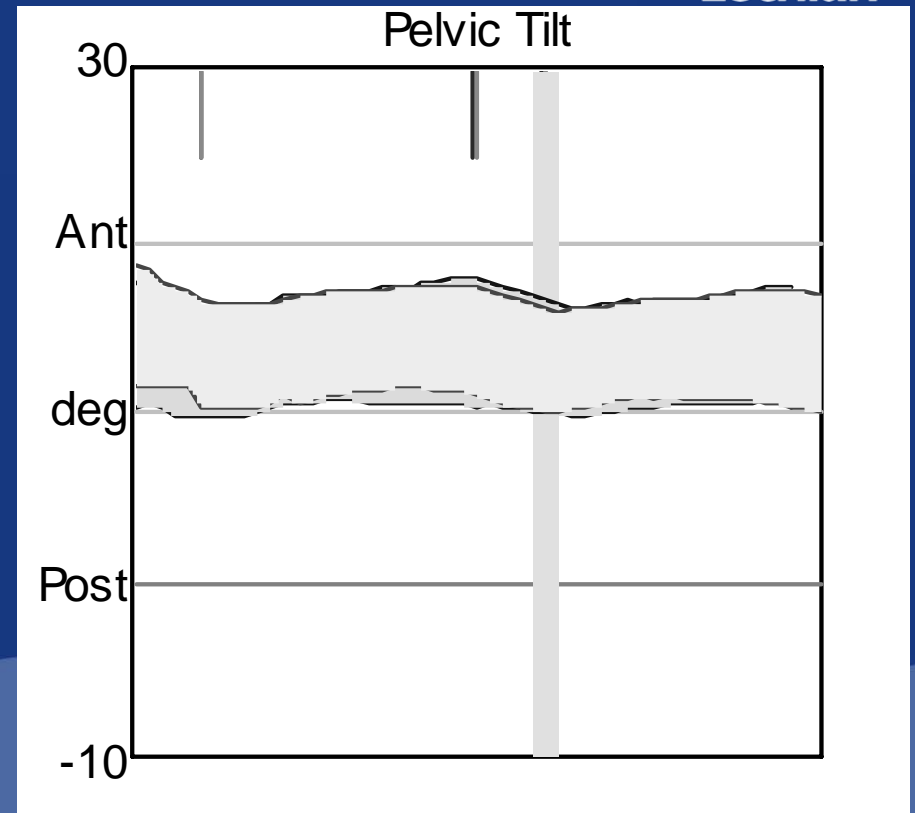
# Comparative Results

- Normal Data Collection
- Patient Data Collection

# Comparative Results – Pelvic Tilt

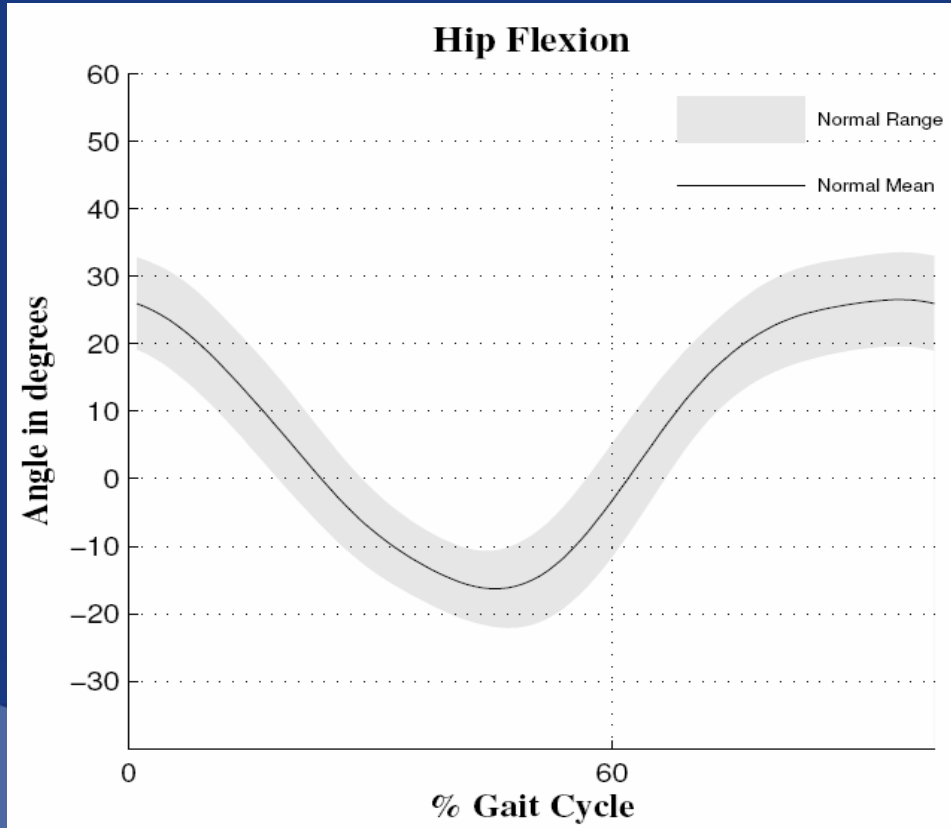


Graph from Specks

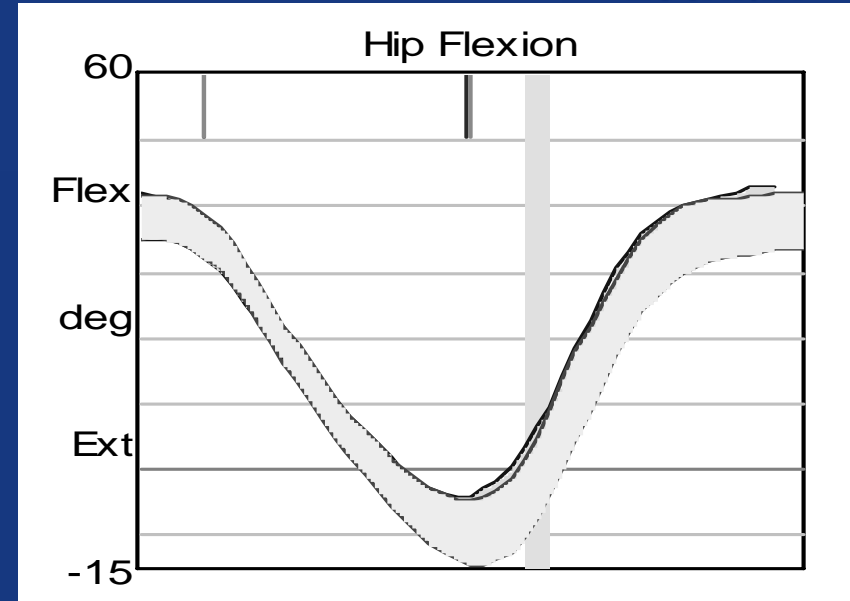


Graph from Vicon

# Comparative Results – Hip Flexion

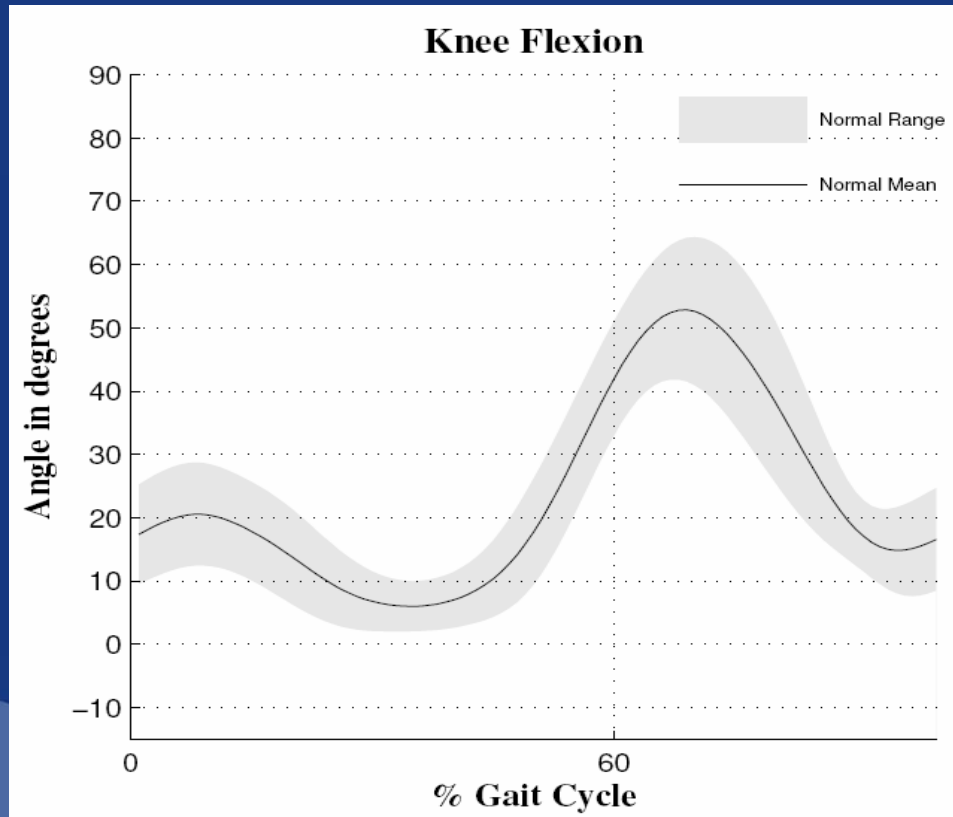


Graph from Specks

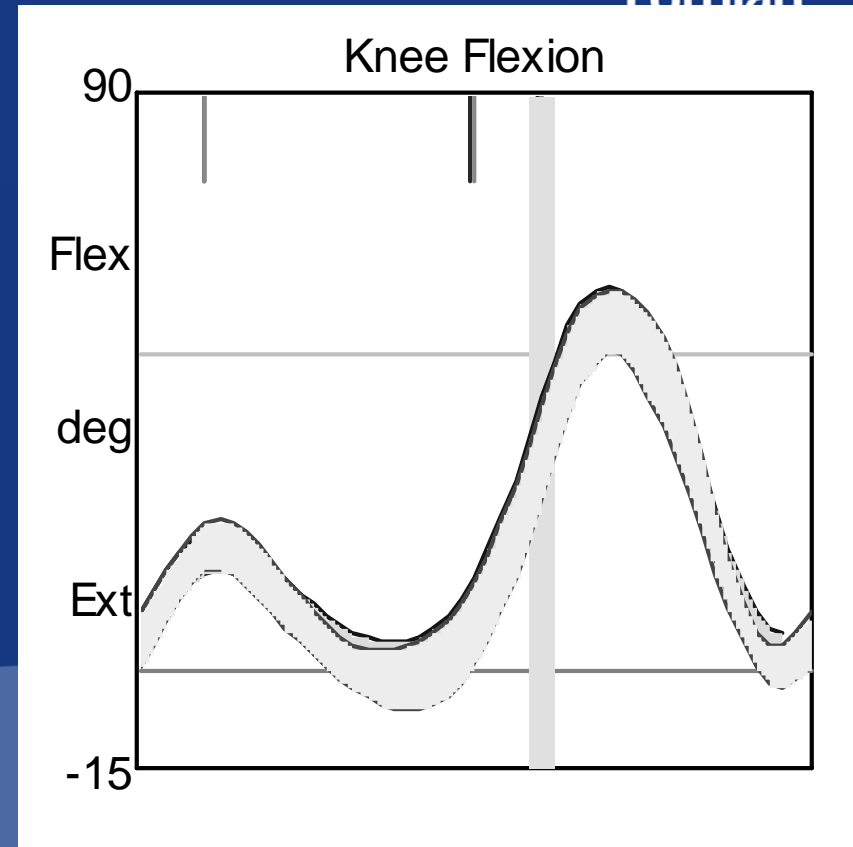


Graph from Vicon

# Comparative Results – Knee Flexion

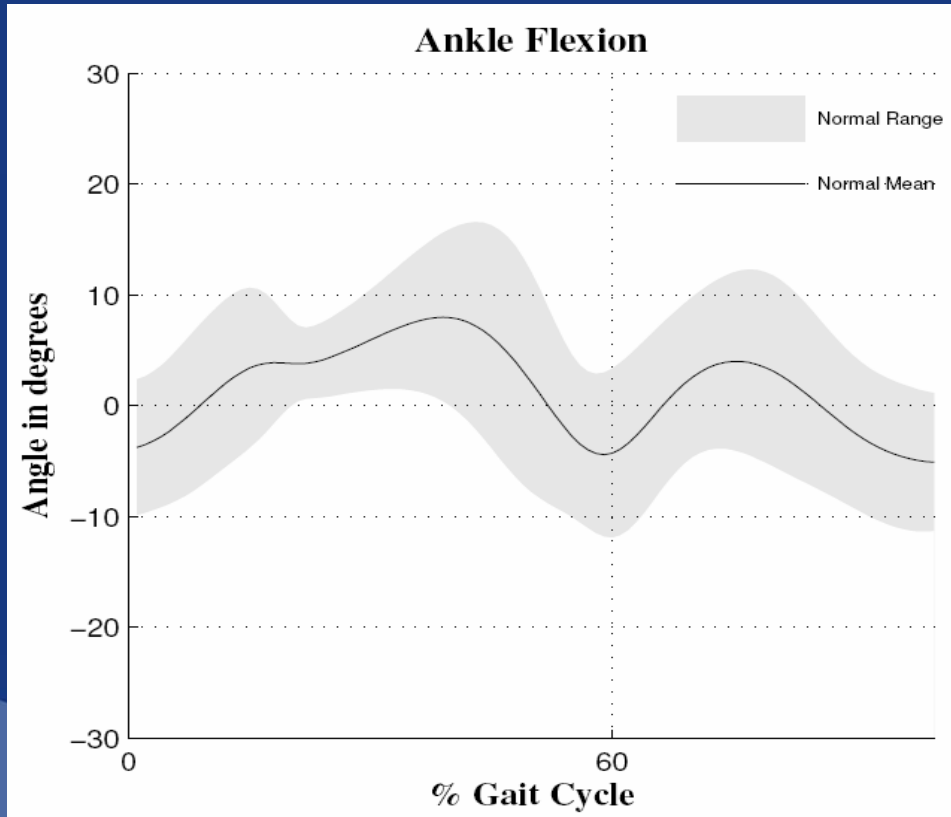


Graph from Specks

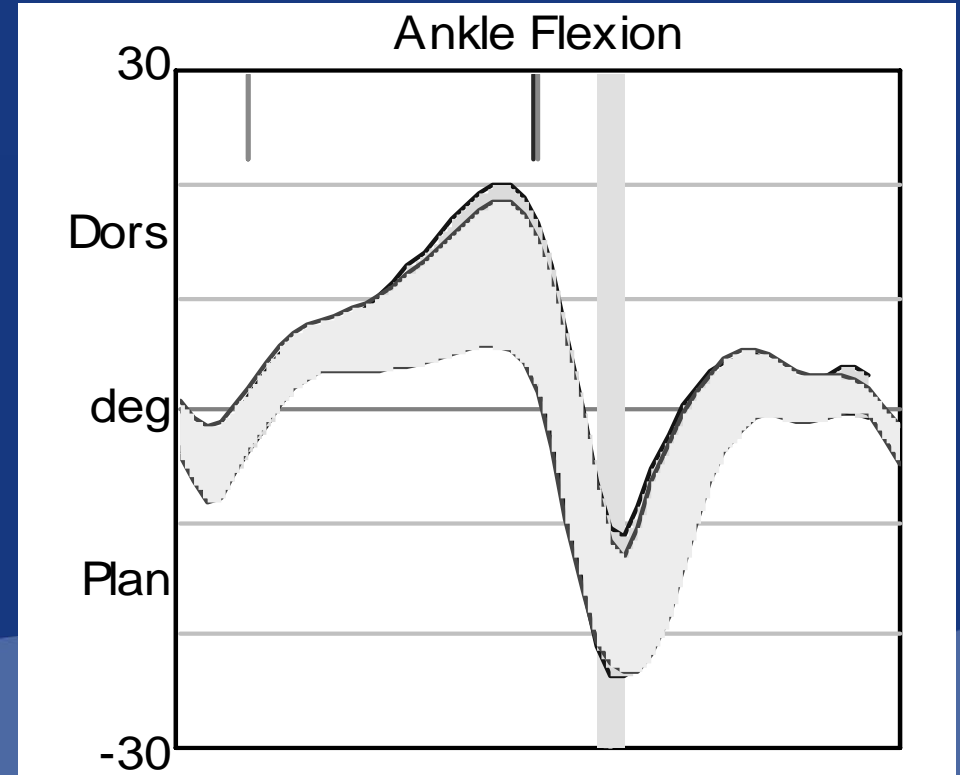


Graph from Vicon

# Comparative Results – Ankle Flexion

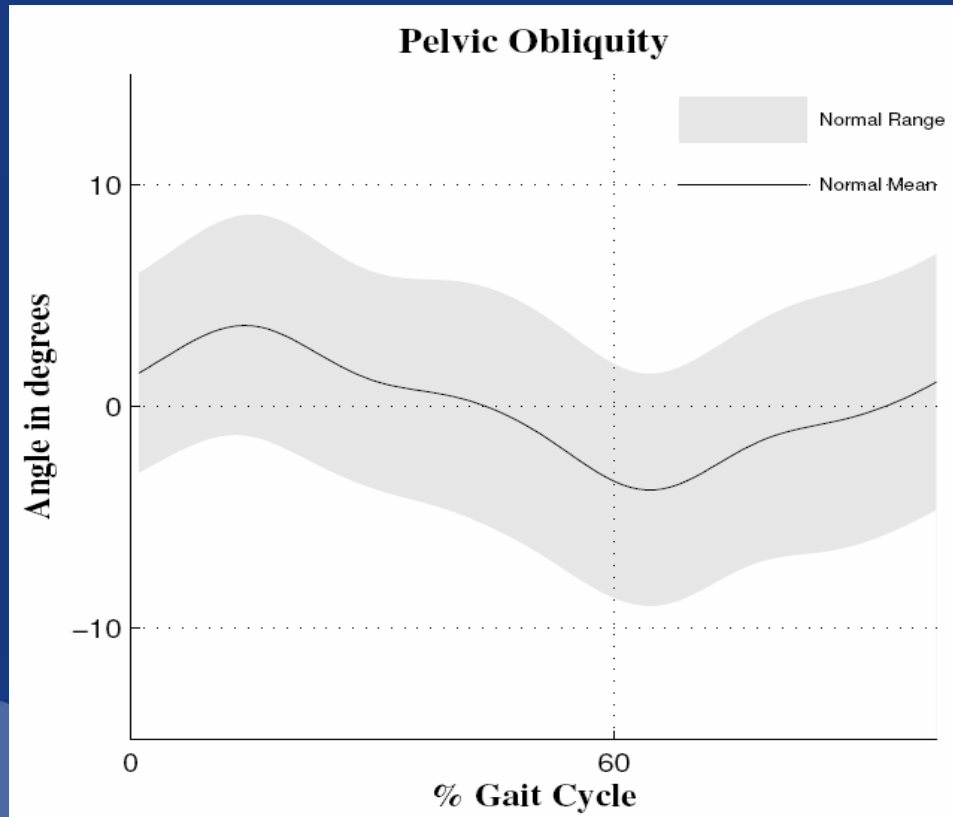


Graph from Specks

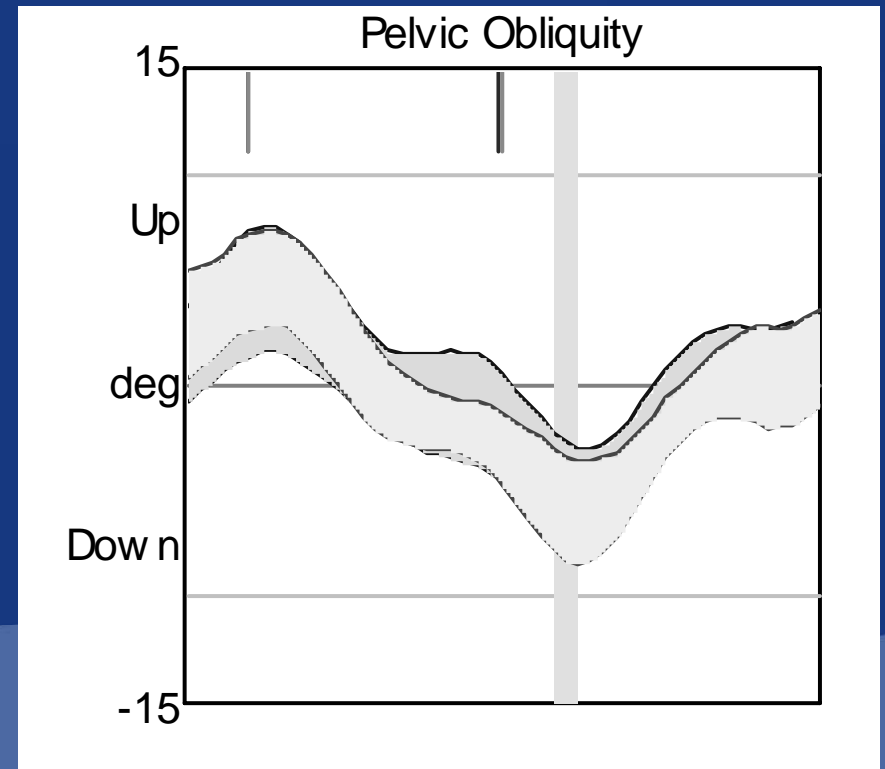


Graph from Vicon

# Comparative Results – Pelvic Obliquity

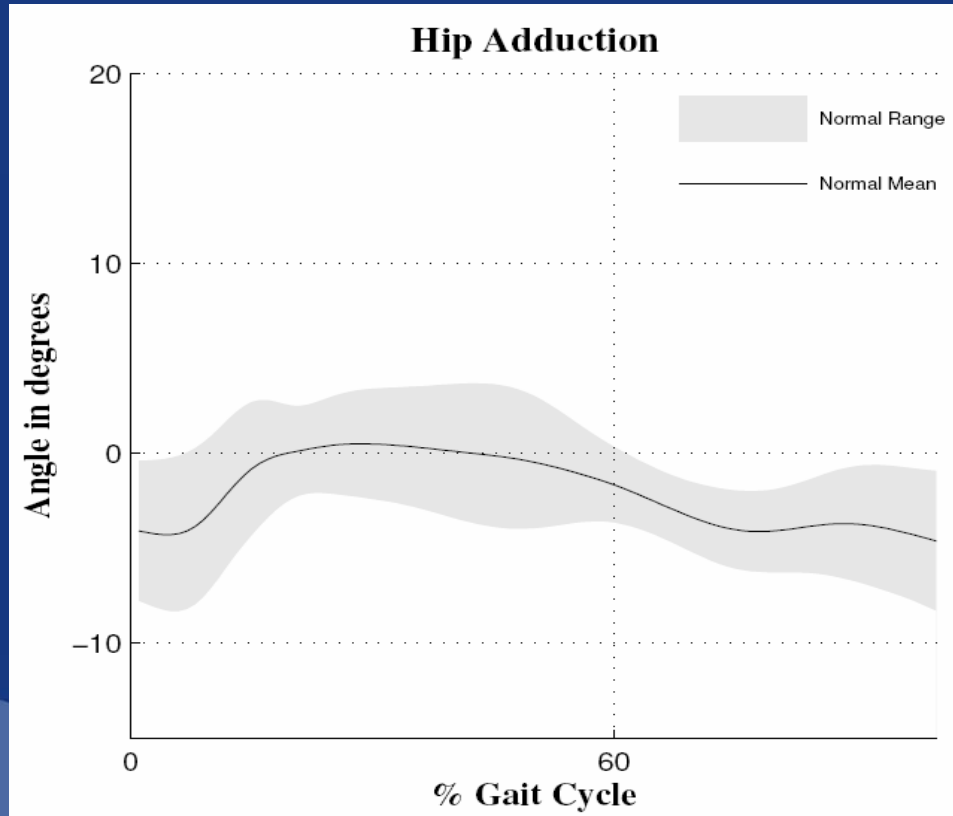


Graph from Specks

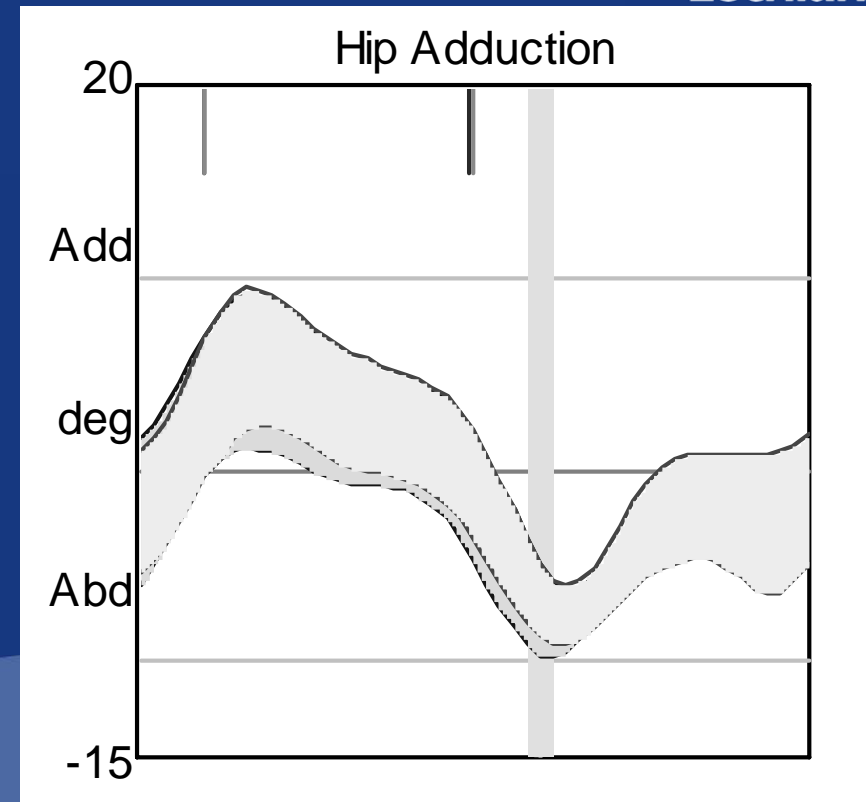


Graph from Vicon

# Comparative Results – Hip Abduction

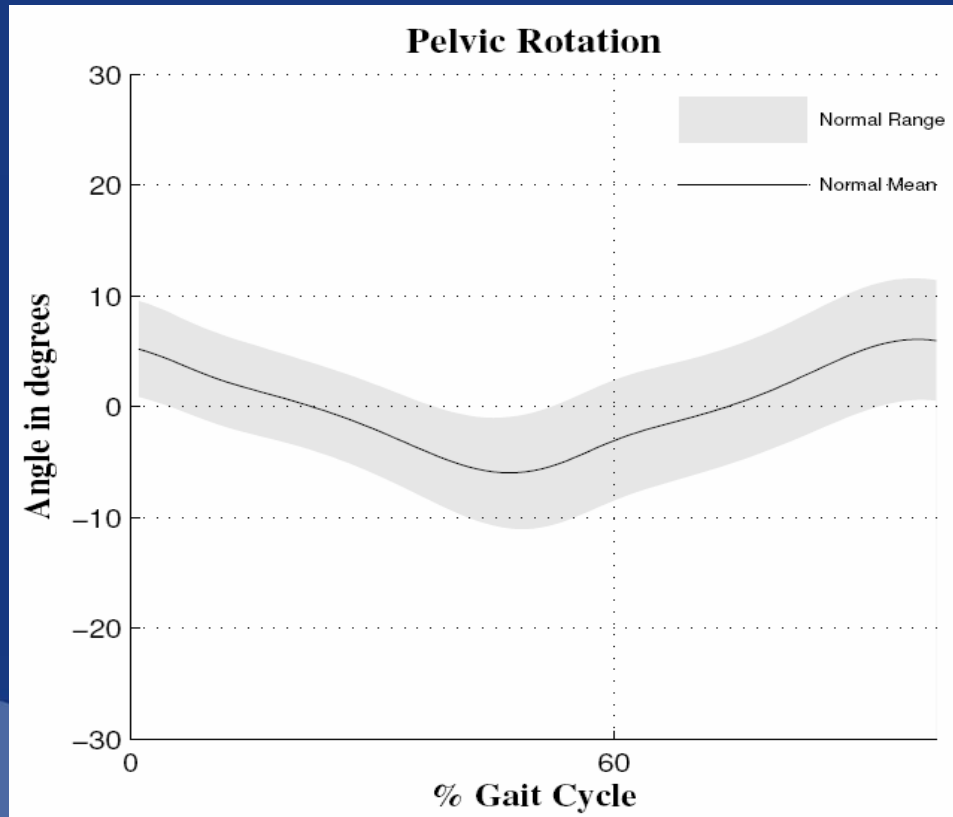


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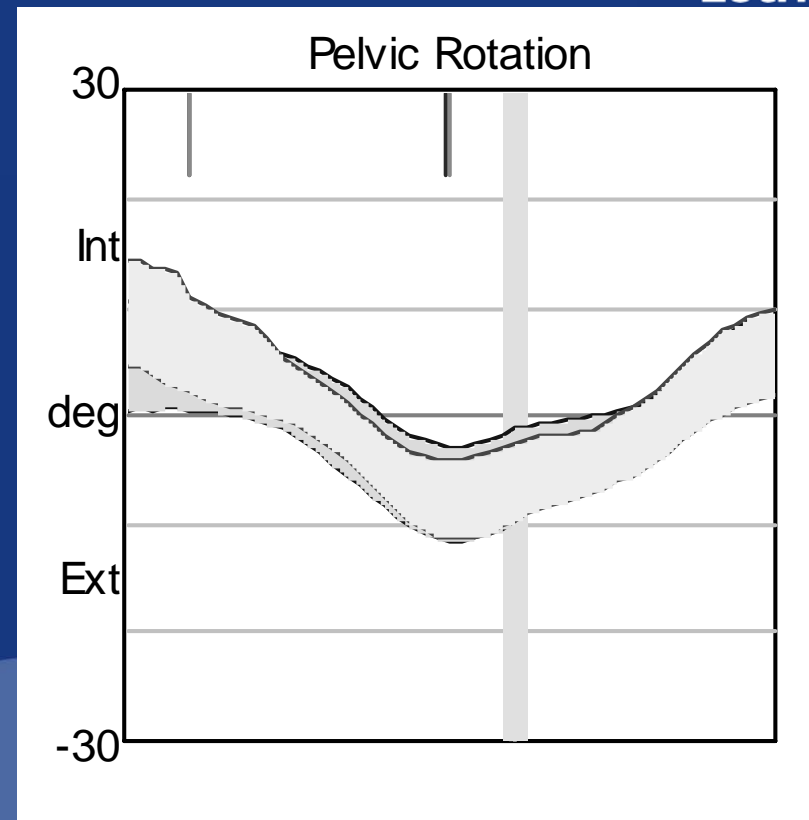


Graph from Vicon

# Comparative Results – Pelvic Rotation

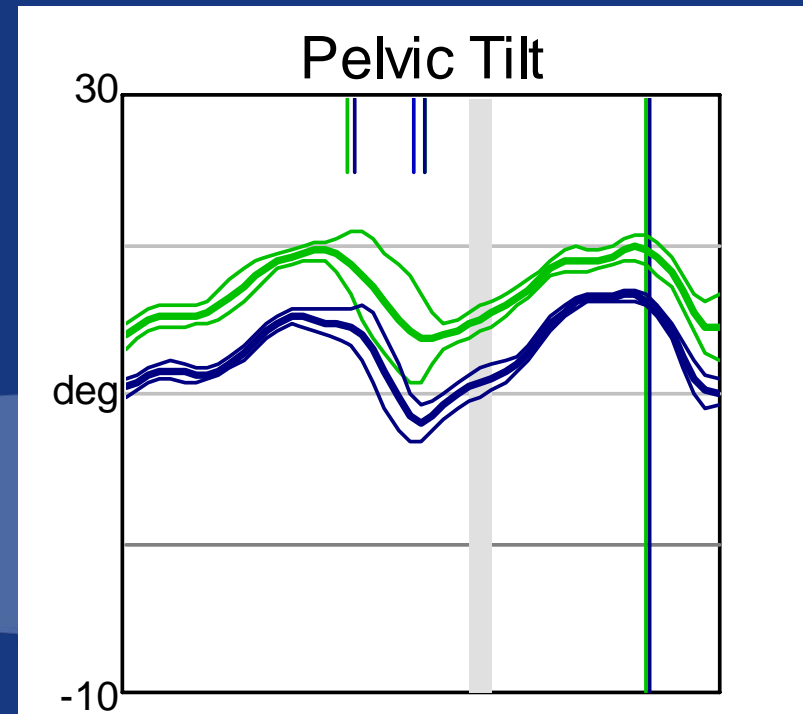
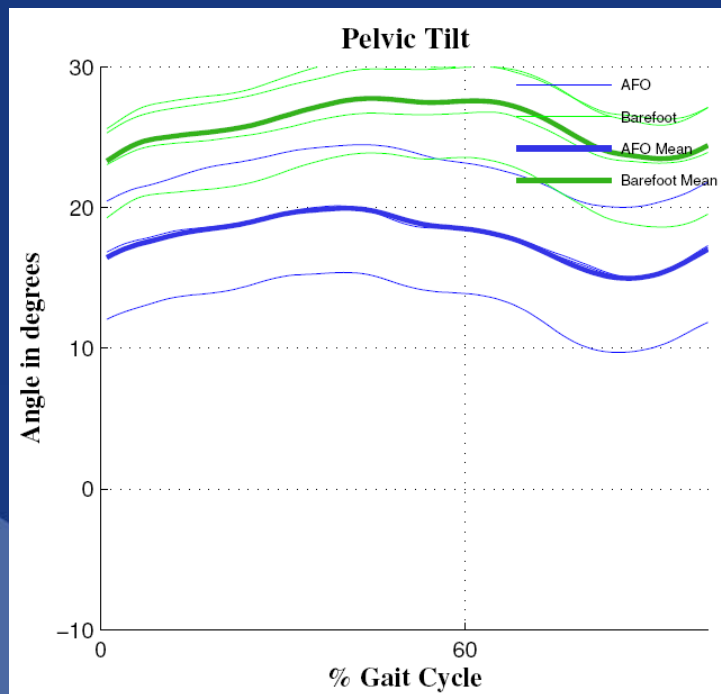


Graph from Specks

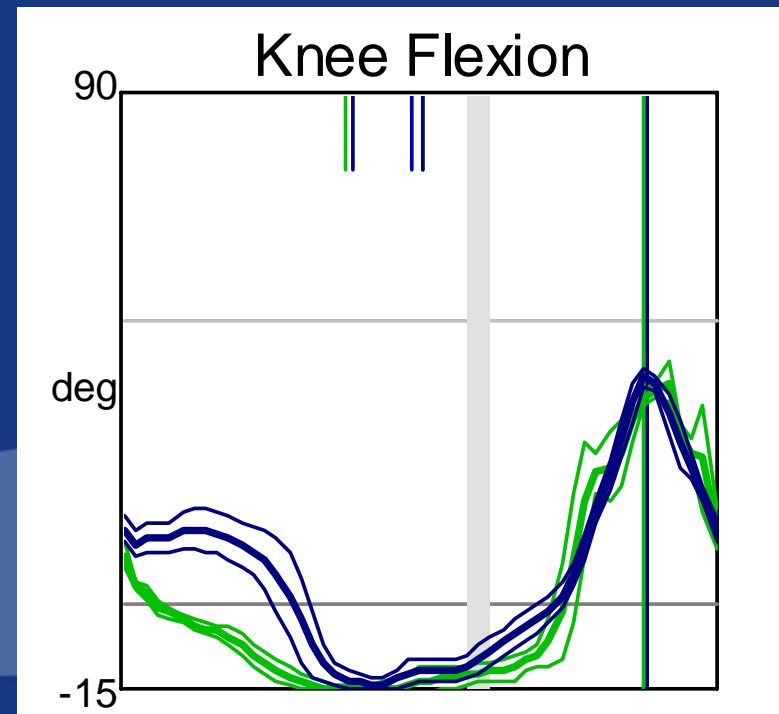
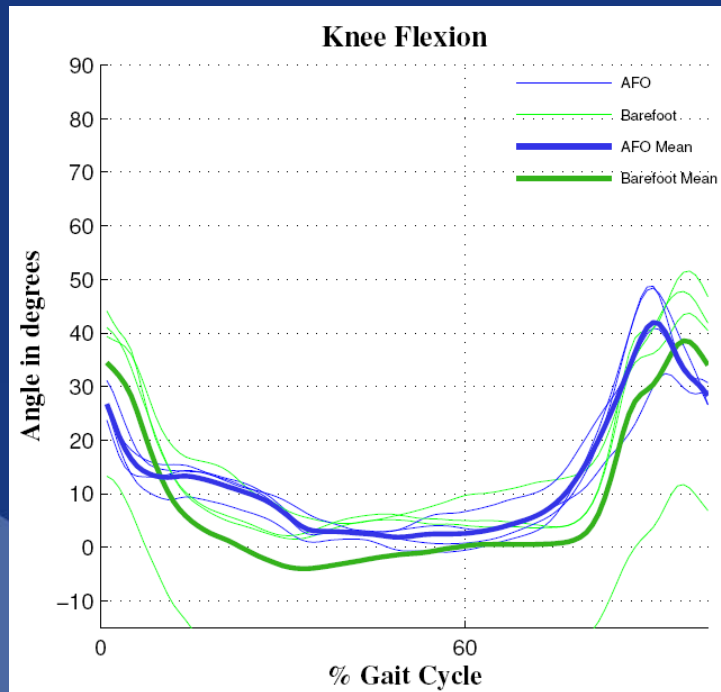


Graph from Vicon

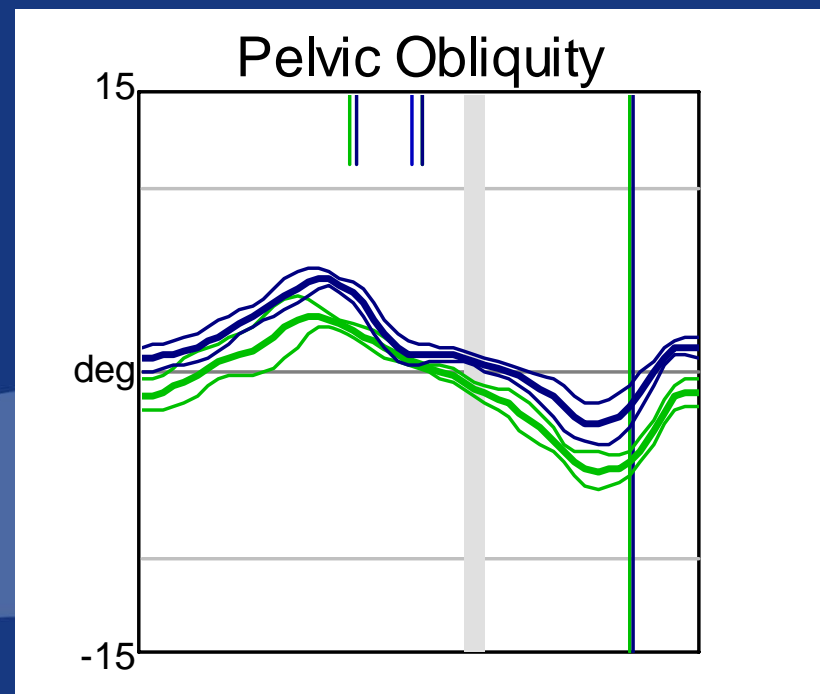
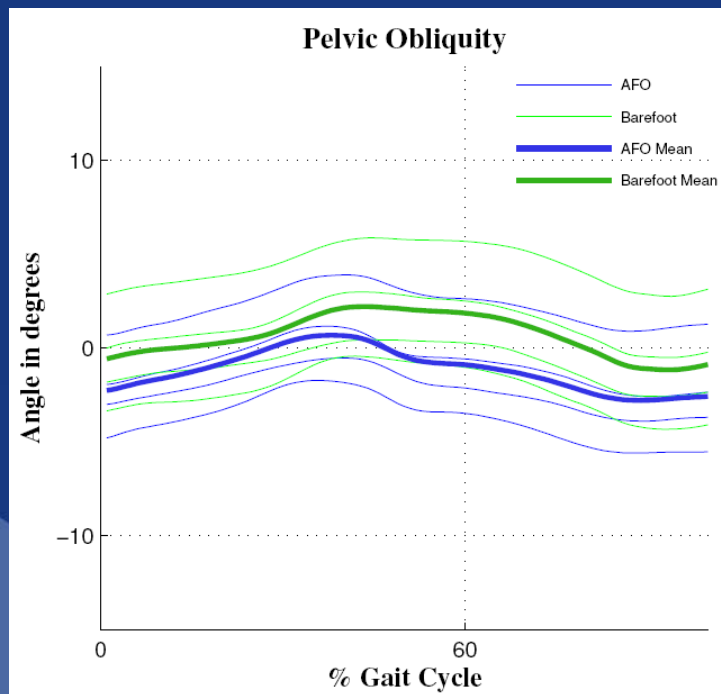
# Patient Data



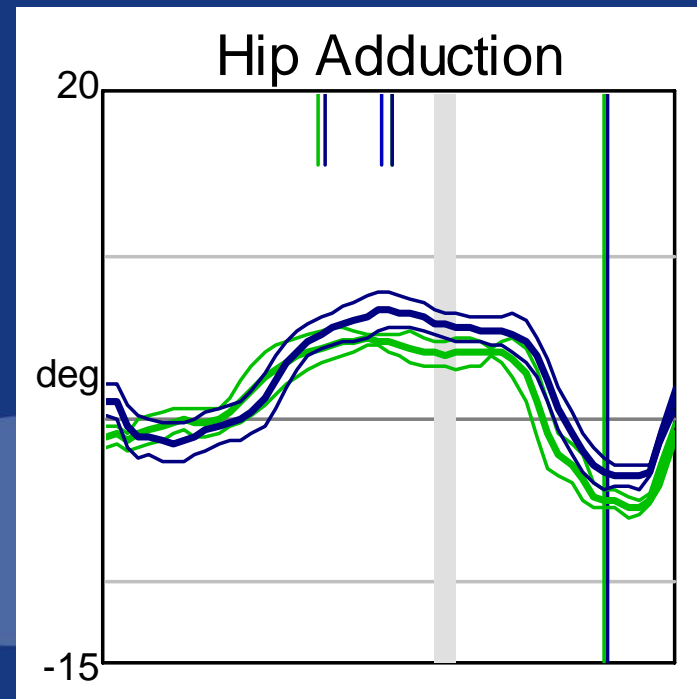
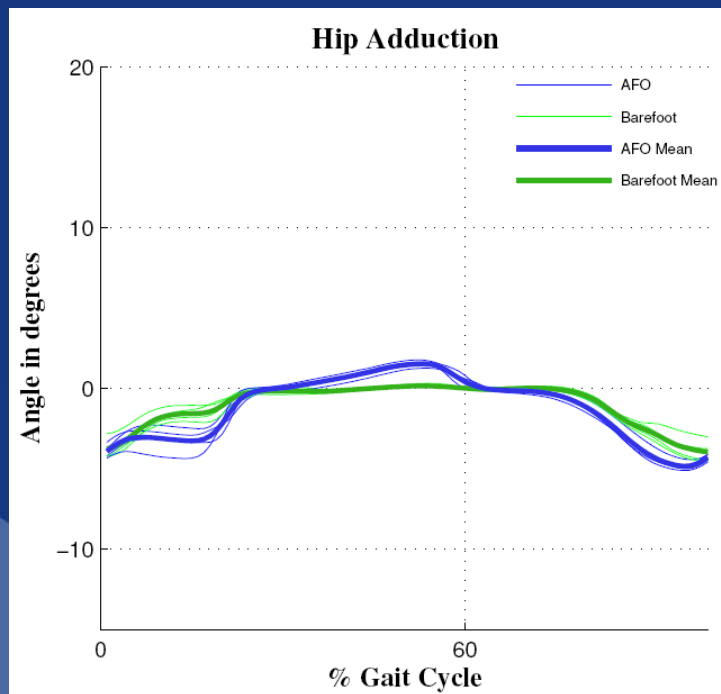
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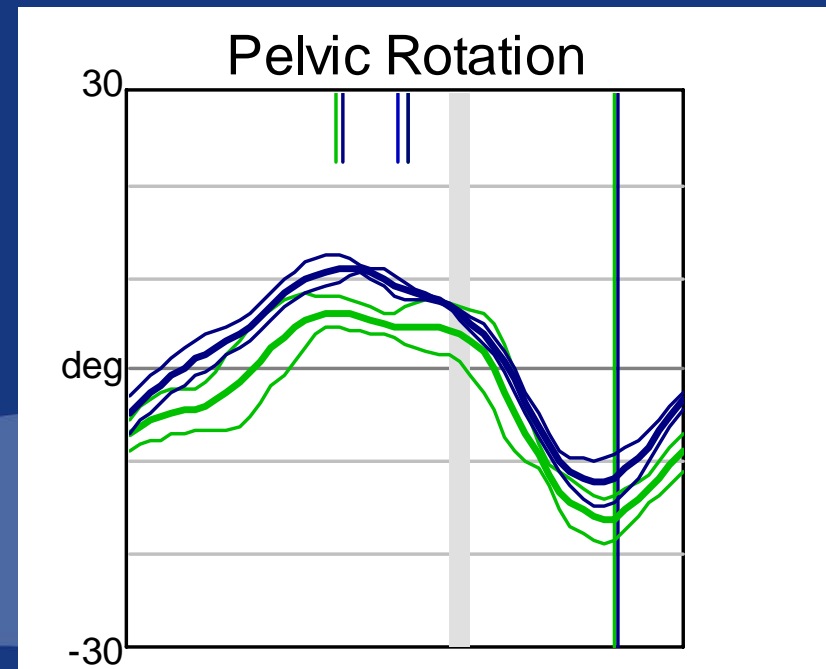
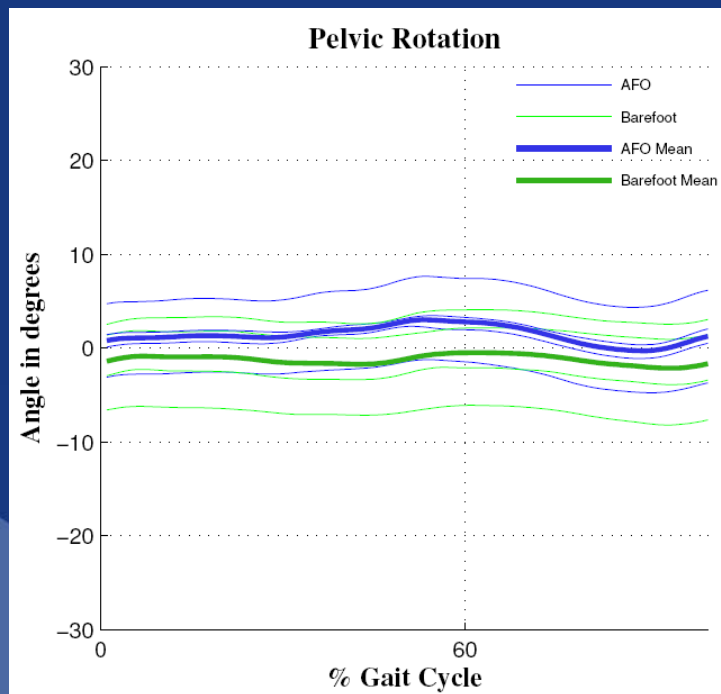
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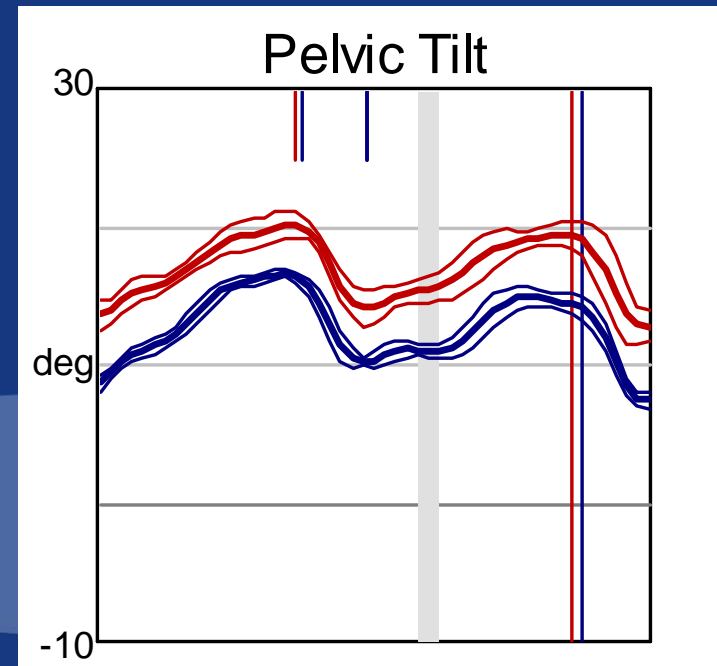
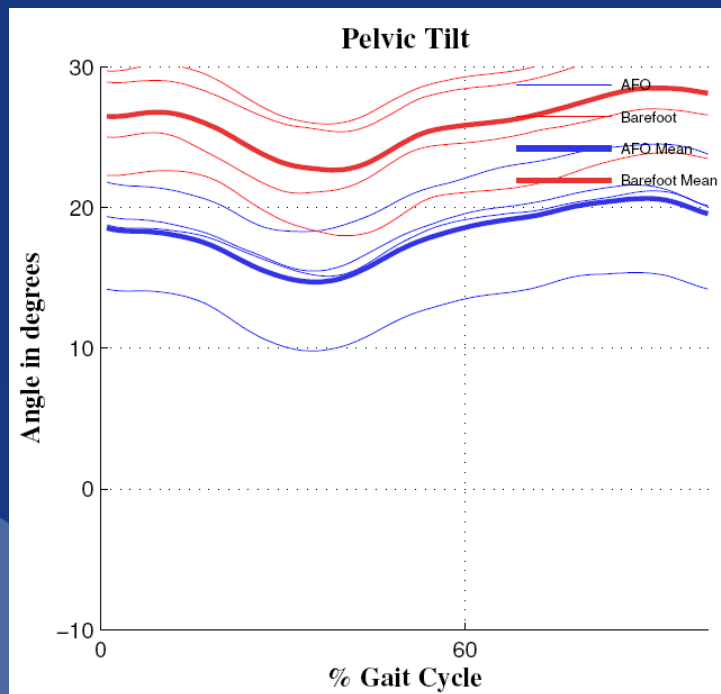
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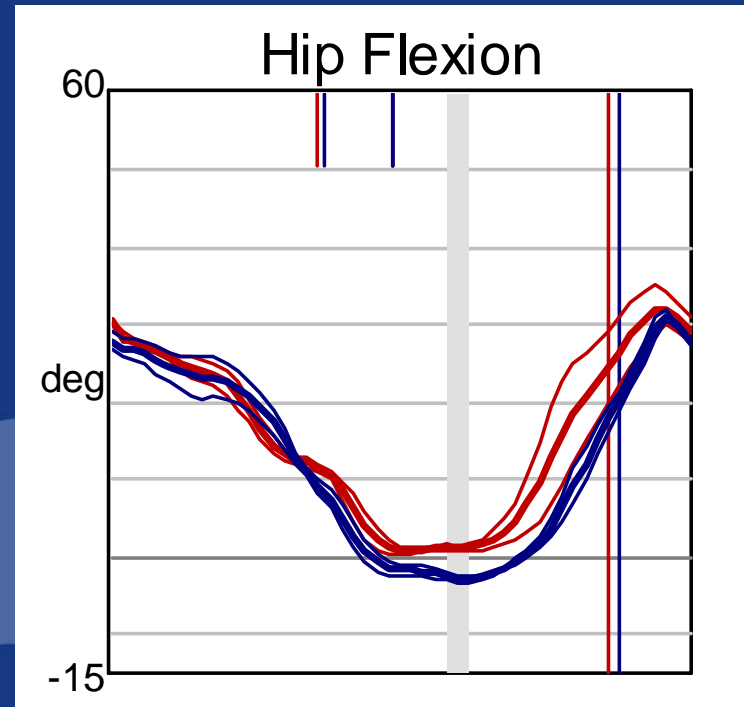
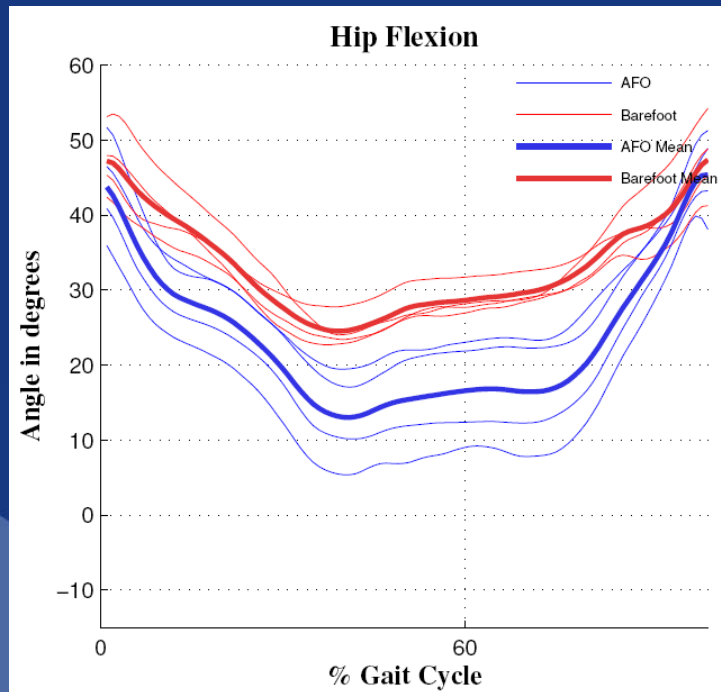
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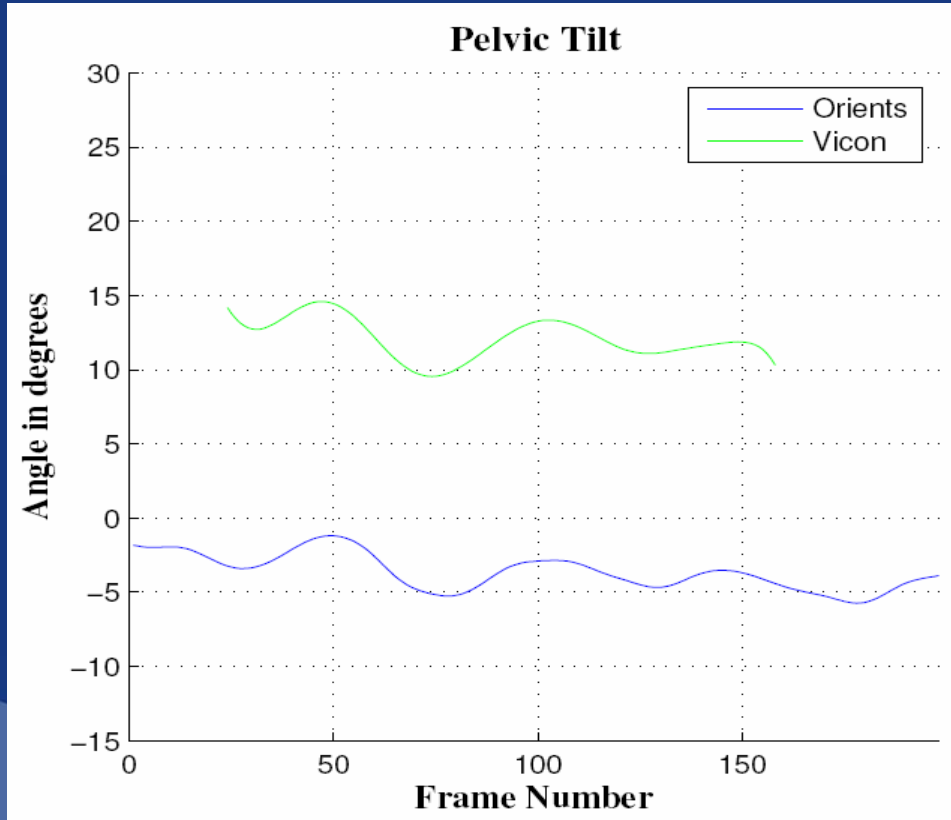


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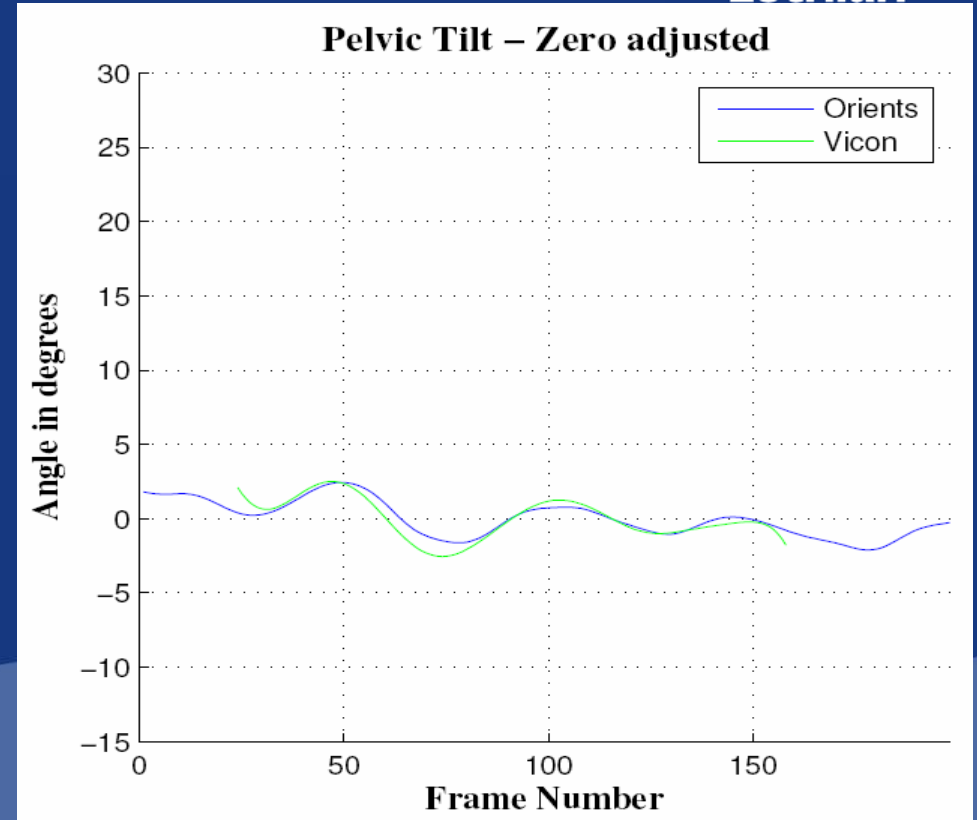


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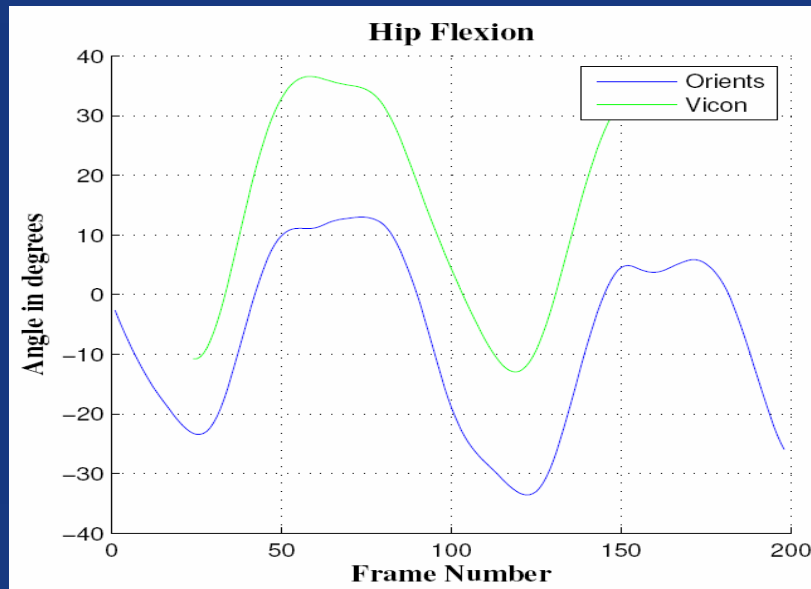




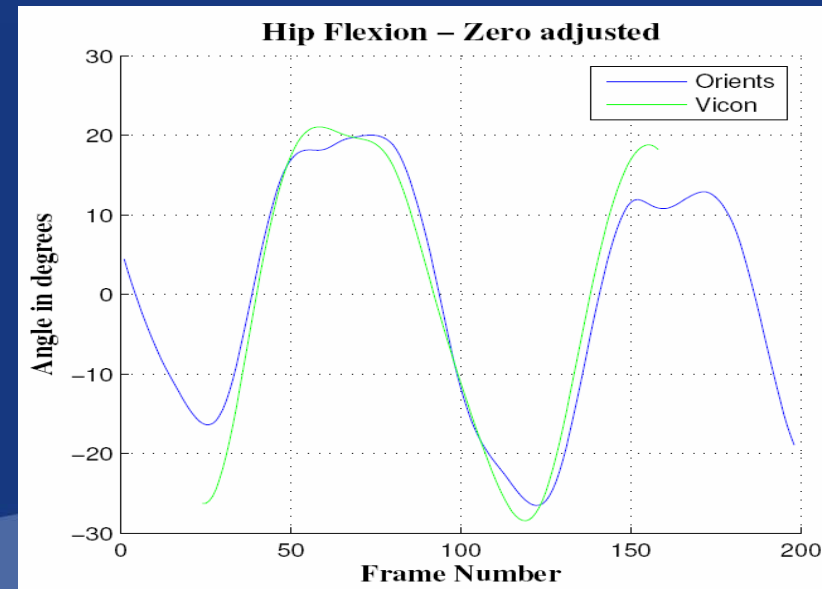
Original Curves



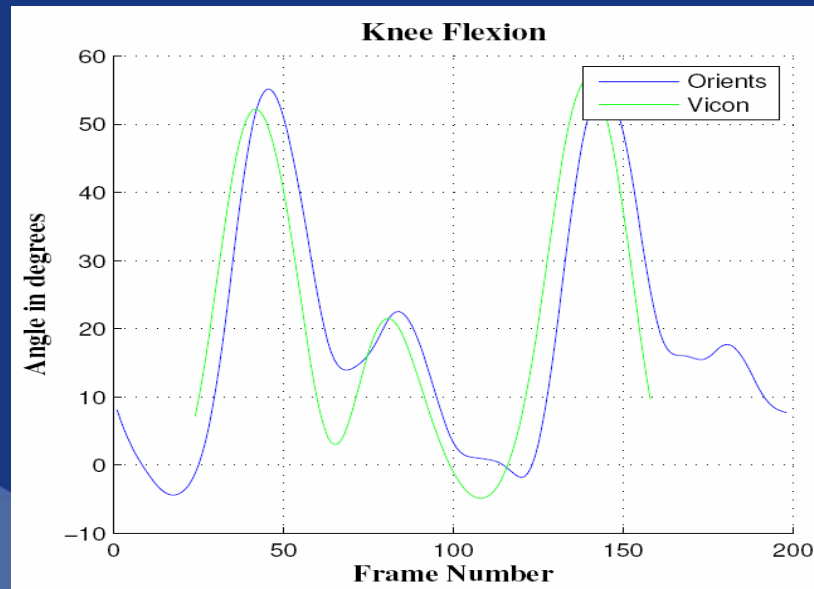
Zero Mean Adjusted



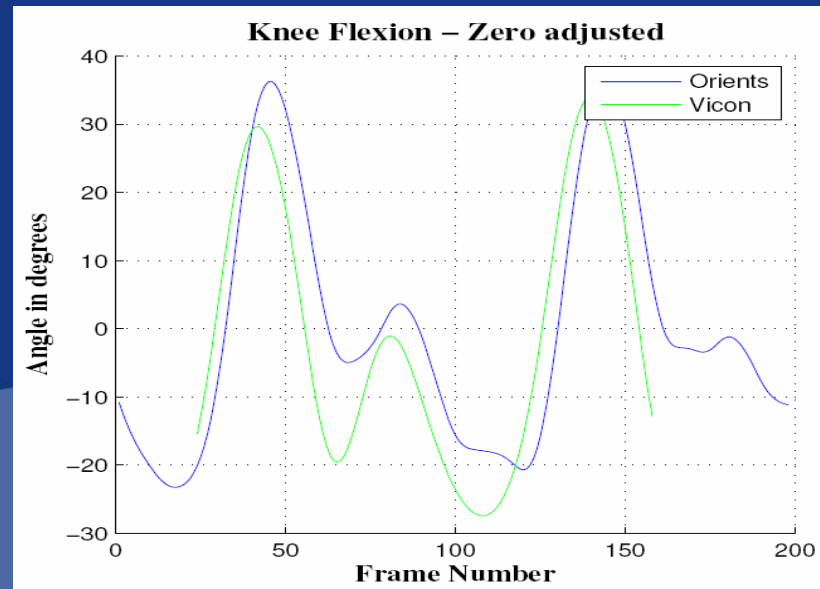
Original Curves



Zero Mean Adjusted



Original Curves



Zero Mean Adjusted

# Analysis of The Use of Specks in Clinical Gait Analysis

- Format of result in line with Gait Analysis reports
- Integration cumulative error, reset at mid-stance
- Reset orientation of markers
- Zero centred magnitudes

# Future work

- Anterior/Posterior pelvic tilt
  - “Root” of calculations
- Position of foot marker
- Orientation of markers



# Future Work

- Design
  - Size
- Transmitting Wire / Internal memory
- Battery life
- Transmission problems
- Segmentation automated for pathological gait

# Summary of The Use of Specks in Gait Analysis

- ✓ Kinematics
  - Angular displacements in 3 planes
  
- Kinetics
  - Forces, moments, powers
  - Force Transducers
  
- Temporal Parameters
  - Walking speed (m/s)
  - Cadence (steps/min)
  - Double/Single support time (s)
  - Stride length (m)
  - Step length (m)
  - Step time (s)



Thank you for your attention