

Transverse Plane: Typical Deviations & Possible Causes

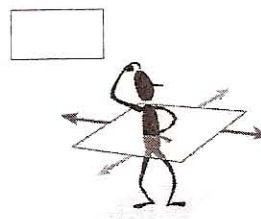
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TRANSVERSE (HORIZONTAL) PLANE

The transverse plane divides the body into upper and lower portions

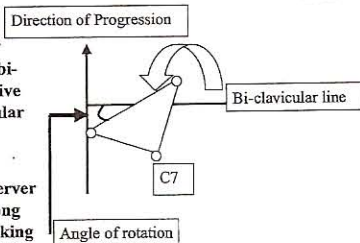


Upper Body

Angle definition

-The motion of the bi-clavicular line relative to a line perpendicular to the direction of progression

- As seen by an observer looking down the long axis of the torso looking from above

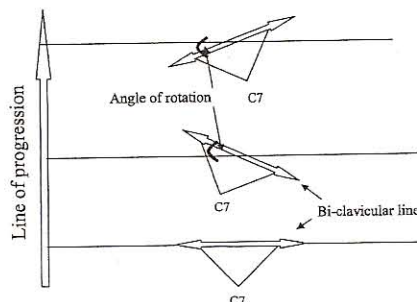


UPPER BODY

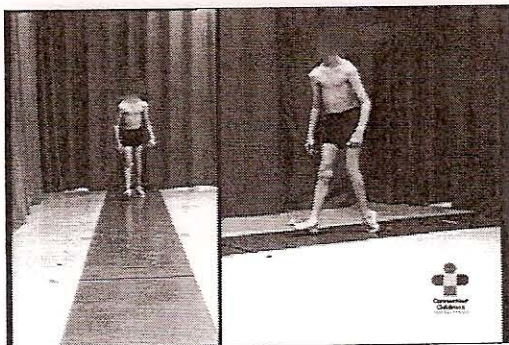
Upper Body Angle Definition:

-The motion of the bi-clavicular line relative to a line perpendicular to the direction of progression

- as seen by an observer looking down the long axis of the torso from above



Upper Body: Asymmetrical Rotation

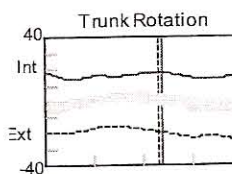


Upper Body: Asymmetrical Rotation

(Internal rotation of one side and external rotation of the other side)

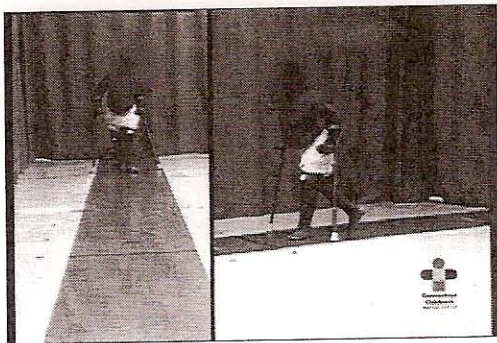
Primary Causes

- Scoliosis
- Asymmetrical trunk/upper extremity tightness/spasticity (hemiplegia)*



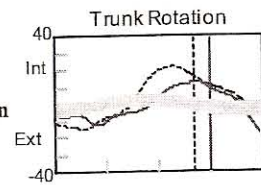
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Upper Body: Increased Excursion of Motion



Upper Body: Increased Excursion of Motion

- **Primary Causes**
 - Aid in forward progression
 - Similar to pelvic motion
- **Secondary Causes**
 - Required for use of assistive devices (crutches)*

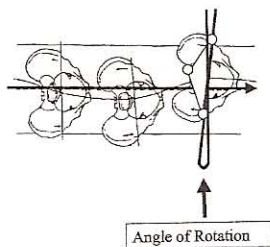


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Pelvis

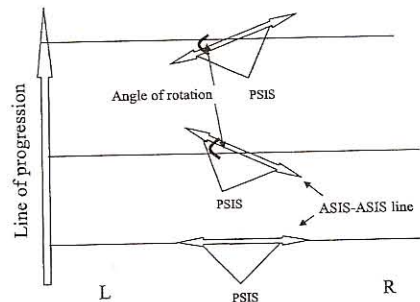
Angle Definition

- The motion of the ASIS to ASIS line relative to a line perpendicular to the direction of progression
- As viewed by an observer whose site line is perpendicular to the pelvic plane

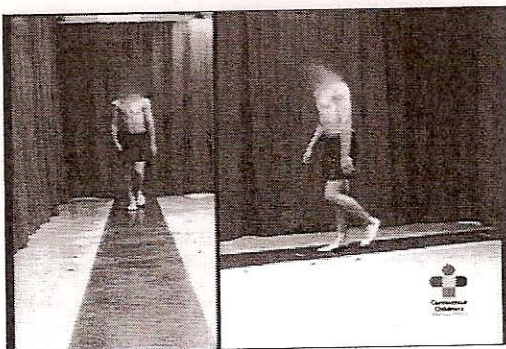


Angle of Rotation

PELVIS

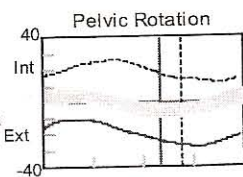


Pelvis: Increased External Rotation



Pelvis: Increased External Rotation

- **Primary Causes**
 - Retraction pattern on involved hemiplegic side*
- **Secondary Causes**
 - Asymmetrical femoral anteversion (compensation for ipsilateral internal hip rotation)
 - Asymmetrical foot progression (compensation for ipsilateral internal tibial torsion)

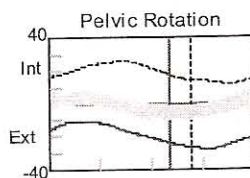


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Pelvis: Increased Internal Rotation

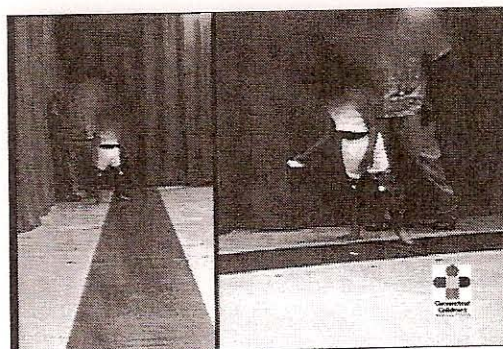
- Secondary Causes

- Obligatory internal rotation resulting from retraction pattern on the contralateral side*



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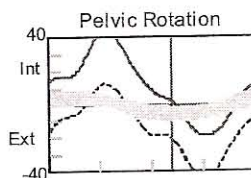
Pelvis: Increased Excursion of Motion



Pelvis: Increased Excursion of Motion

- Primary Causes

- Increased step lengths
- Compensation for reduced sagittal plane excursion of motion*



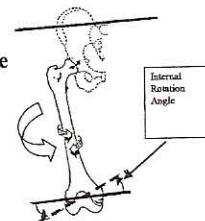
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Hip

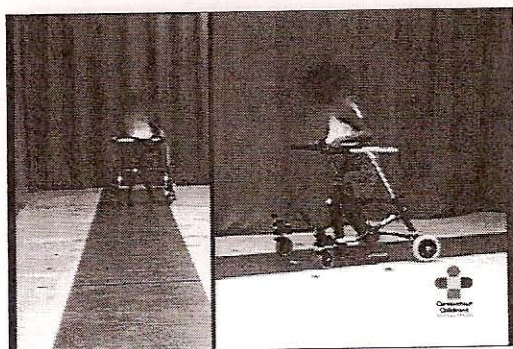
Angle definition

- The motion of the thigh (as defined by the knee flexion extension axis) relative to the ASIS - ASIS line

- As viewed by an observer above the pelvic plane



Hip: Increased Internal Rotation



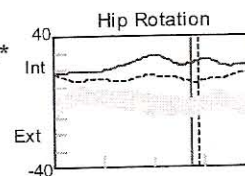
Hip: Increased Internal Rotation

- Primary Causes

- Excessive internal femoral anteversion*
- Internal rotator tightness/spasticity

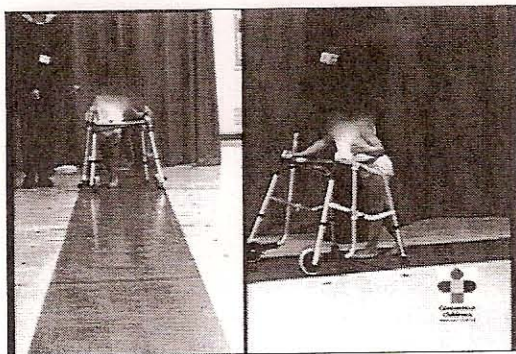
- Secondary Causes

- Unilateral internal hip rotation can be compensation for external pelvic rotation



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Hip: Increased External Rotation



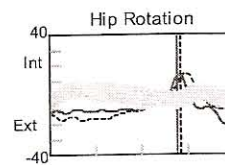
Hip: Increased External Rotation

• Primary Causes

- Femoral retroversion
- Poor balance
- Increased thigh girth

• Secondary Causes

- Unilateral external rotation can be compensation for internal pelvic rotation
- Compensatory to internal tibial torsion*



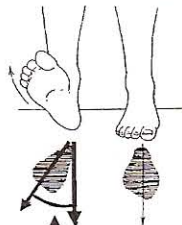
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Foot

Angle Definition

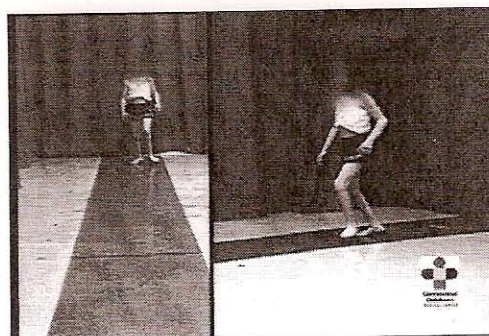
- The angle between the long axis of the foot (ankle center along to space between 2nd and 3rd metatarsals) and the direction of progression

- As seen from above



Angle of Rotation

Foot: Increased External Progression



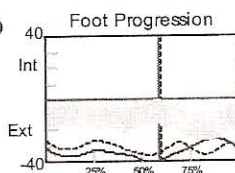
Foot: Increased External Progression

• Primary Causes

- Midfoot break (forefoot abduction)

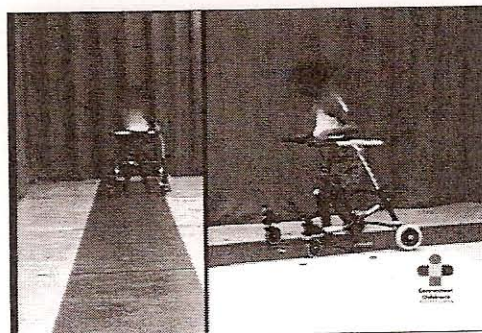
• Secondary Causes

- Increased external tibial torsion*
- External hip rotation
- External pelvic rotation
- Foot drag with external rotation
- Circumduction of the foot for clearance (swing)
- External rotation in the transverse plane through the knee joint



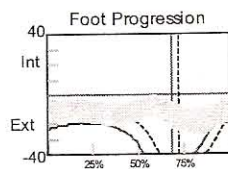
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Foot: Increased Dynamic External Progression at Toe-Off



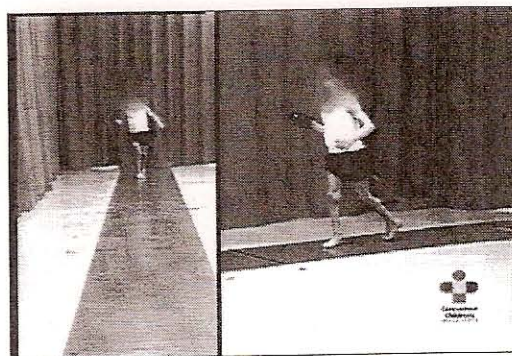
Foot: Increased Dynamic External Progression at Toe-Off

- Primary Causes
 - Foot drag in swing due to clearance problems*



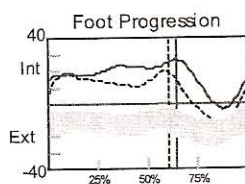
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Foot: Increased Internal Progression



Foot: Increased Internal Progression

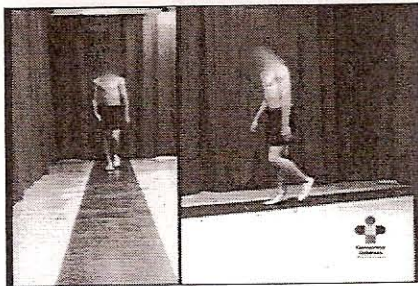
- Primary Causes
 - Posterior tibialis spasticity
 - Anterior tibialis spasticity/peroneal weakness
 - Forefoot adductus
- Secondary Causes
 - Internal tibial torsion*
 - Internal hip rotation
 - Internal pelvic rotation
 - Foot drag with internal rotation
 - Internal rotation in the transverse plane through the knee joint



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Misconceptions in Interpretation

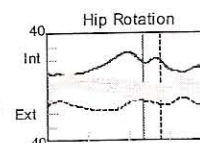
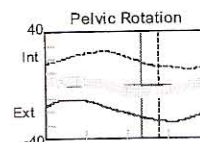
1. Knees Pointing Straight Versus Asymmetrical Pelvic and Hip Rotation



Visual impression of this patient is of normal hip rotation bilaterally

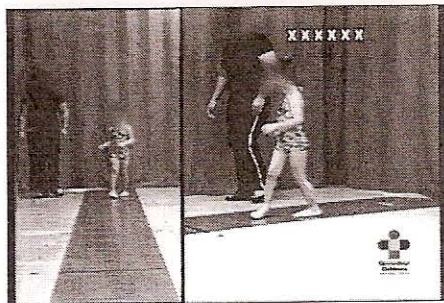
1. Knees Pointing Straight Versus Asymmetrical Pelvic and Hip Rotation

- Kinematic data indicate asymmetrical pelvic and hip rotations
- Asymmetry in pelvic and hip motion can lead to a visual impression of symmetry
- In the presence of an asymmetrical pelvic rotation, determining the degree of hip rotation as noted by knee position from the front view can be misleading



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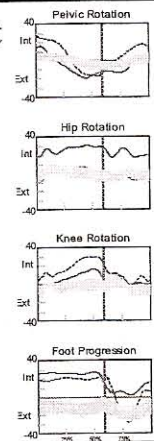
2. Bilateral Internal Foot Progression



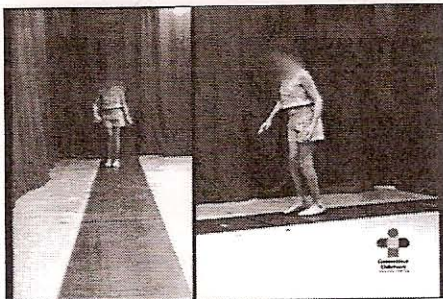
Visual impression of this patient is of bilateral internal hip and foot progression

2. Bilateral Internal Foot Progression

- A combination of the pelvis, hip, femur, knee and tibia may cause abnormal foot progression
- Kinematic data indicate asymmetrical pelvis and hip rotations
- In this case, internal hip rotation on the right results in internal foot progression
- In this case, internal pelvic rotation on the left results in internal foot progression



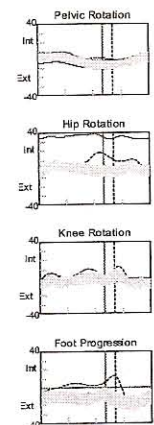
3. Neutral Foot Progression Versus Internal Hip Rotation and External



Visual impression of this patient is of neutral foot progression

3. Neutral Foot Progression versus Internal Hip Rotation and External Tibial Torsion

- Combinations of abnormal rotations of the pelvis, hip, knee, and tibia can "cancel" each other out.
- In this case an excessive external tibial torsion on the right is masked by internal hip rotation on the right.



Transverse Plane Abnormalities

- The entire transverse plane profile must be assessed (trunk, pelvis, hip, knee, and foot) simultaneously to accurately determine at which level/levels the rotational abnormalities are present.
- Both transverse plane motion plots and clinical examination estimations of bony torsions are important for the understanding of rotational abnormalities.

Questions ???