Pathologic Gait

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Overview: etiology of pathologic gait deviations

- Compensation of gait:
  - Muscle weakness
  - Pain
  - Soft tissue injury
  - Bony injury
  - Neurologic dysfunction
History and Physical Exam

- **History**
  - Congenital
  - Acquired
  - Degenerative

- **Examination**
  - Musculoskeletal
    - ROM
    - Joint
    - Soft tissue
      - Muscle
      - Connective tissue
    - Bone

- **Neurologic**
  - General
  - Focal
  - Paralysis
    - Spastic
    - Flaccid
  - Sensation
    - Pain
    - Light touch
    - Proprioception
  - Balance
    - Central
    - Vestibular
    - Visual
Motor Control

- Recruitment
  - Timing
  - Quantity
- “Derecruitment”
  - Timing
  - Quantity
Other Factors

- Cardiac
- Pulmonary
- Fatigue
Gait Analysis

- Kinematics
  - Temporal and spatial joint/limb movement

- Qualitative
  - Observational gait analysis

- Quantitative

https://www.youtube.com/watch?v=-WnLC-yJBwo&feature=player_embedded
Gait Analysis

- Kinetics
  - Forces/torques that produce joint/limb movement
Summary of Pressures during Stance Phase
Normal Gait

Diagram showing the normal gait cycle with phases:
- Double support
- R. Single support
- Double support
- L. Single support
- Double support

Stance phase:
- R. Stance phase
- L. Stance phase

Swing phase:
- R. Swing phase
- L. Swing phase
Normal Gait

Stance Phase

Swing Phase
Hip ROM during normal gait cycle

FIG 13–8.
Hip motion involves only 1 arc of flexion and 1 arc of extension. (Adapted from Perry J: Clin Orthop 1974; 102:18.)
Knee ROM during normal gait cycle

FIG 13–7.
The knee attains 35 degrees of flexion by the end of stance. Peak flexion is reached in the first third of swing while the limb is in a trailing position. (Adapted from Perry J: Clin Orthop 1974; 102:18.)
Ankle ROM during normal gait cycle

**Fig 13-6.** Ankle motion during the gait cycle ranges from 10 degrees of dorsiflexion to 20 degrees of plantar flexion. (Adapted from Perry J: Clin Orthop 1974; 102:18.)
Ankle dorsiflexor weakness/paralysis

- Loading phase “foot slap”
- Footdrop (toe drag) in swing phase
- Excessive swing phase hip/knee flexion
- Ex. Fibular (peroneal) nerve palsy affecting anterior tibialis function
Ankle plantarflexor weakness/paralysis

- Uncontrolled ankle rotation during loading response to midstance
- Uncontrolled heel and toe off in terminal stance and preswing
- Loss of “propulsion” with an appearance of dropoff in latter stance phase
- Ex. Tibial nerve palsy affects gastrosoleus function
Quadriceps weakness/paralysis

- Affects all phases of gait
- Knee extension at initial contact
- 15-20 degrees knee flexion at midstance--loss of control of knee flexion in loading phase
- Loss of knee extension at terminal stance
- Loss of knee extension at terminal swing
- Ex. Femoral neuropathy
Hamstrings weakness/paralysis

- Uncontrolled knee extension and hip flexion—terminal swing
- Uncontrolled swing phase limb deceleration—loss of eccentric hamstrings contraction
- Harsh initial contact
- Difficulty placing the swing limb for initial contact
- Ex. Sciatic neuropathy
Hip extensor weakness/paralysis

- Gluteus maximus—loss of eccentric hip extension control in loading response
- Sudden posterior thrust of trunk after initial contact
- Ex. Inferior gluteal nerve palsy
Hip flexor weakness/paralysis

- Iliopsoas—loss of hip flexion in early swing phase
- Ex. Femoral neuropathy, lumbosacral plexopathy
Hip abductor weakness/paralysis

- Gluteus medius—"dropping" of the pelvis on the affected side in loading and midstance, resulting in Trendelenburg gait

- Ex. Superior gluteal neuropathy, myopathy
Ataxia

- Impaired balance
- Lack of motor coordination
- Widened base of support
- Variable step length
- Associated movements are exaggerated (lurch, stagger)
- Watches feet

- Ex. Brainstem CVA, olivopontocerebellar atrophy, Friedreich’s ataxia
Parkinsons/Parkinsonism

- Poor posture
- Short step length
- Shuffling
- Lack of associated movements (reciprocating)
- Festination

- Ex. Parkinsons disease
Hemiplegia

- Synergy
  - Upper limb flexor
  - Lower limb extensor
  - Ex. CVA, TBI, MS, CP

- Spasticity
  - Velocity-dependent increase in resistance to muscle stretch after upper motor neuron injury
  - Spastic dystonia
Hemiplegia
Upper extremity flexion synergy

- Scapular retraction and depression
- Shoulder internal rotation
- Shoulder adduction
- Forearm pronation
- Elbow flexion
- Wrist flexion
- Finger flexion
Hemiplegia
Lower extremity extension synergy

- Pelvic elevation
- Hip extension, adduction, internal rotation
- Knee extension
- Ankle plantarflexion
- Foot inversion
- Toe plantarflexion
- Hallux extension
Hemiplegia

- Stance phase:
  - “slap”/equinovarus
  - Knee flexion/extension
  - Trendelenburg/extension
  - Hip flexion/extension
  - Toe drop off/clenching

- Swing phase:
  - Adductor swing
  - Circumduction
  - Toe drag
  - Sound limb vaulting
Equinus

- Ankle plantarflexion inversion spasticity
- Stance phase
  - Initial contact midfoot/forefoot
  - Weight bearing shifted laterally
- Swing phase
  - Toe drag
- Ex. CVA, TBI, MS, CP
Scissor

- Hip adductor spasticity
- Narrowed base of support
- Knee crosses midline--stance and swing

- Ex. Cerebral palsy
Antalgia

- Deviation dependent on pain location and severity
- Affected side—decreased stance phase
- Non-affected side—decreased step length
Antalgia

- **Joint/bone:**
  - Arthritis
  - Fracture

- **Soft tissue injury**
  - Bursitis
  - Tendonitis
  - Sprain/strain
  - Overuse
  - DOMS