The Hallway Gait Examination

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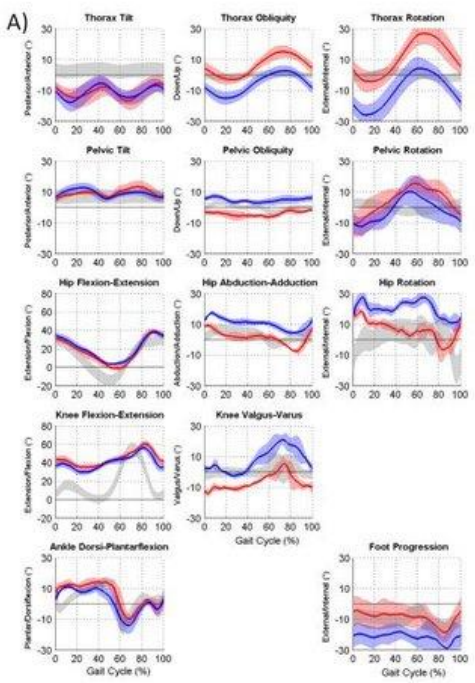
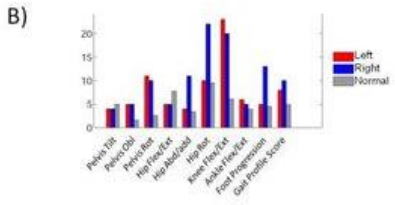
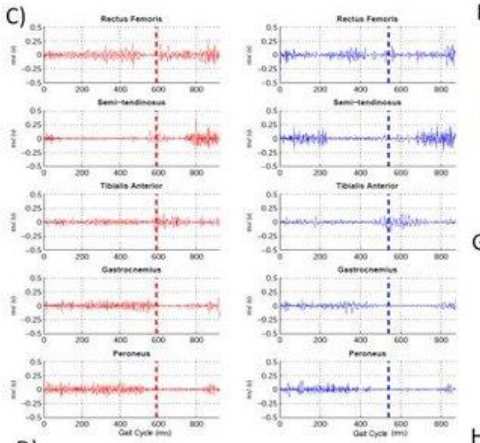
- I have no relevant disclosures related to this talk.

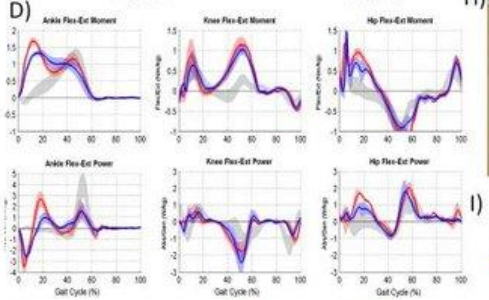
- Gait analysis is an important part of many Orthopedic consultations
  - Anatomic considerations
  - Biomechanical considerations
  - Neurological considerations
  - Physiologic considerations
- Formal Gait analysis is not always readily available
  - Expensive facility
  - Qualified staff
  - Time consuming

Formal Gait Analysis





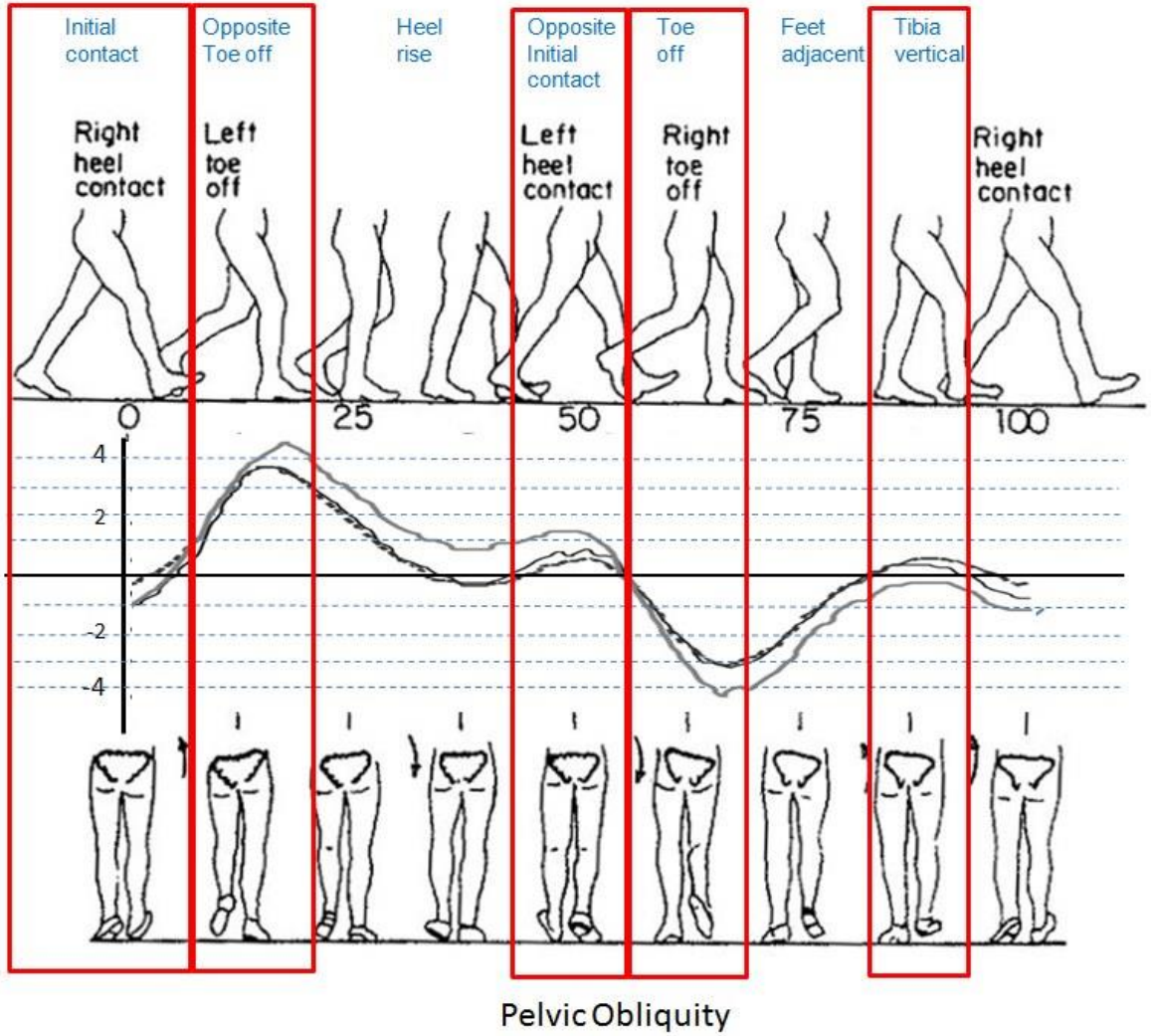




E)

	Left	Right
Walking speed (m/s)	0.82 ± 0.15	0.84 ± 0.15
Cadence (steps/min)	131.1 ± 4.99	133.37 ± 14.39
Step length (m)	0.32 ± 0.03	0.44 ± 0.05
Step width (m)	0.16 ± 0.04	0.11 ± 0.05
Stance (%)	65.96 ± 3.65	63.49 ± 3.1
Step time (s)	0.43 ± 0.06	0.48 ± 0.05
Stride time (s)	0.92 ± 0.11	0.91 ± 0.11
Stride length (m)	0.75 ± 0.06	0.76 ± 0.06
Single support	36.66 ± 2.58	33.94 ± 3.41

The Normal Gait Cycle

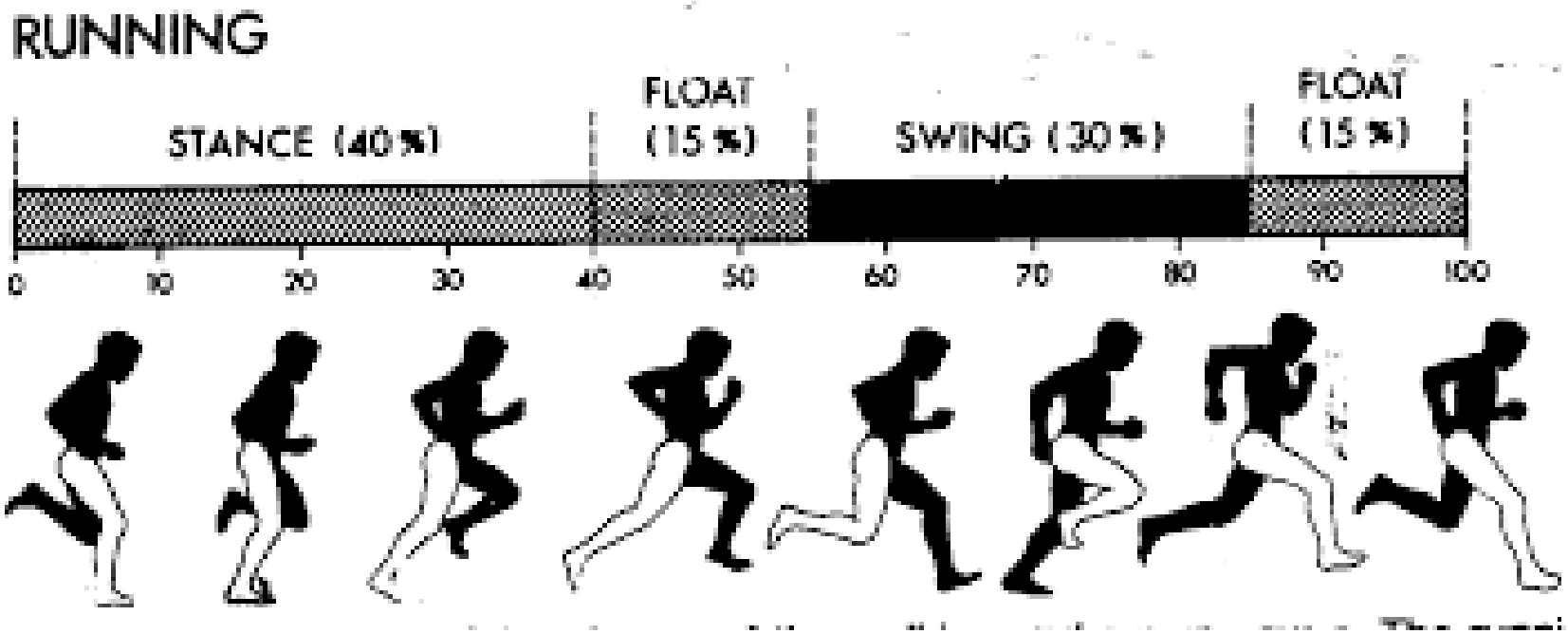


The Normal Gait Cycle

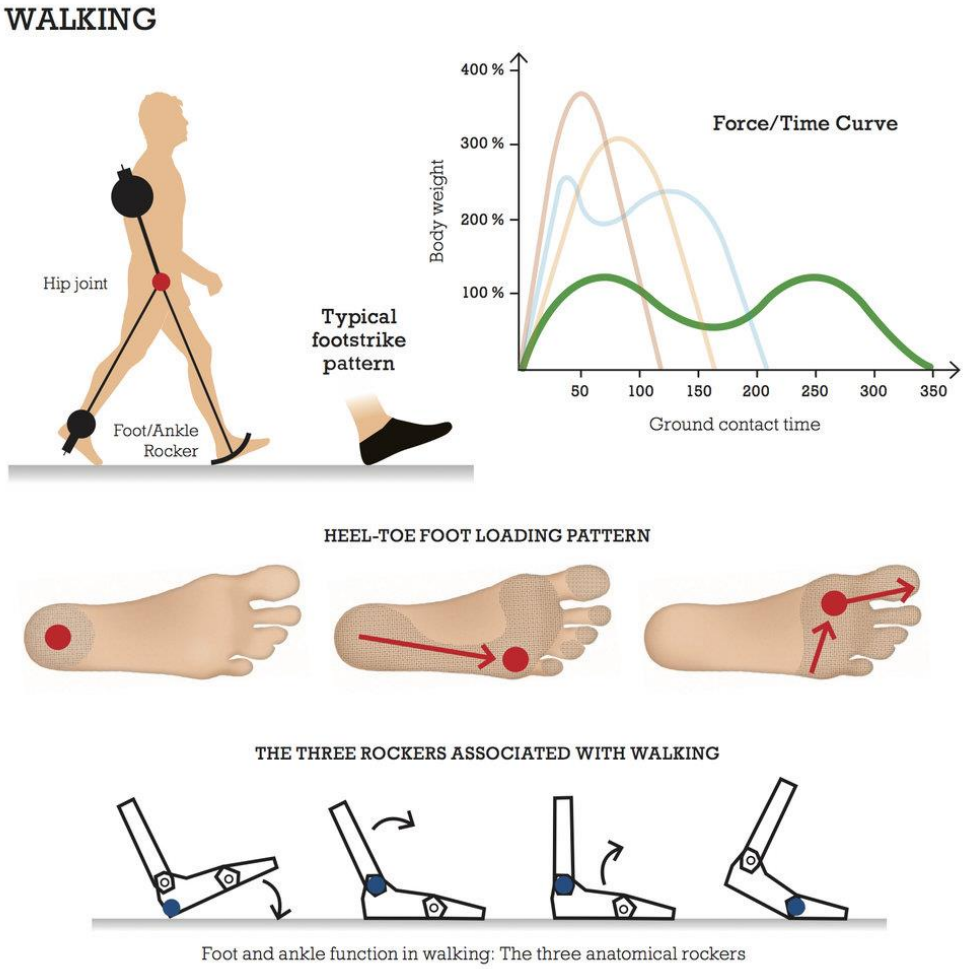
Critical Events in Each Phase of Gait

Periods	Stance Period					Swing Period		
Tasks	Weight Acceptance		Single Limb Support		Swing Limb Advancement			
Phases	Initial Contact (0%)	Loading Response (0-10%)	Mid Stance (10-30%)	Terminal Stance (30-50%)	Pre Swing (50-60%)	Initial Swing (60-75%)	Mid Swing (75%-87%)	Terminal Swing (87-100%)
Temporal Events	Initial Contact	B: Initial Contact E: Opposite Foot-off	B: Opposite Foot-Off E: Heel-off (body leads foot)	B: Heel-off (body leads foot) E: Opposite initial contact	B: Opposite initial contact E: Foot-off	B: Foot-off E: Feet adjacent (knee extends)	B: Feet adjacent (knee extends) E: Tibia Vertical	B: Tibia vertical E: Initial contact
Critical Events	• Heel first initial contact	• Hip stability • Controlled knee flexion for shock absorption • Controlled ankle PF	• Controlled tibial advancement	• Controlled ankle DF with heel rise • Trailing limb posture	• Passive knee flexion to 40° • Rapid ankle PF	• Max knee flexion (>60°)	• Max hip flexion (30°) • DF to neutral	• Knee extension to neutral

The Running Gait Cycle

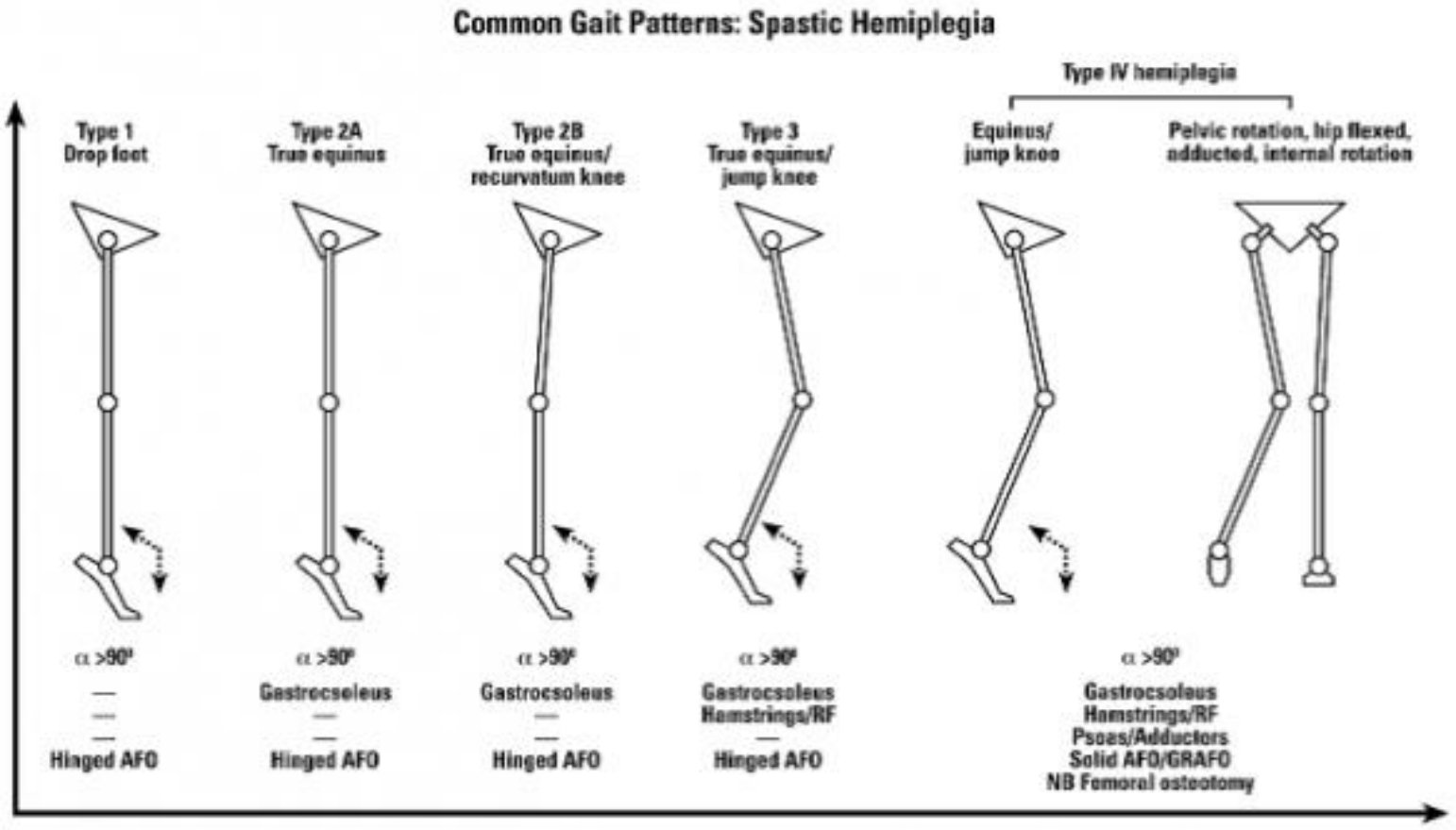


Foot pressures

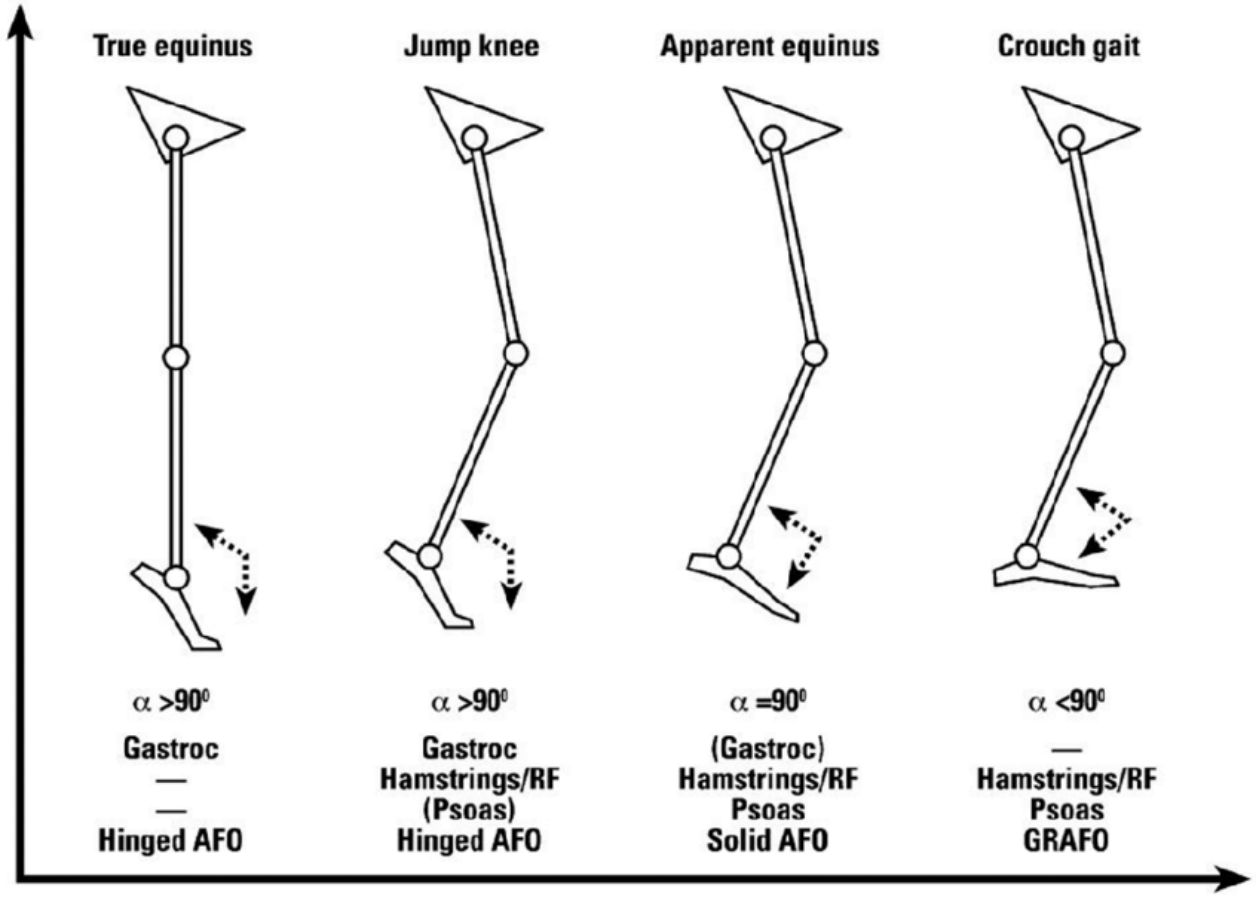


Foot and ankle function in walking: The three anatomical rockers

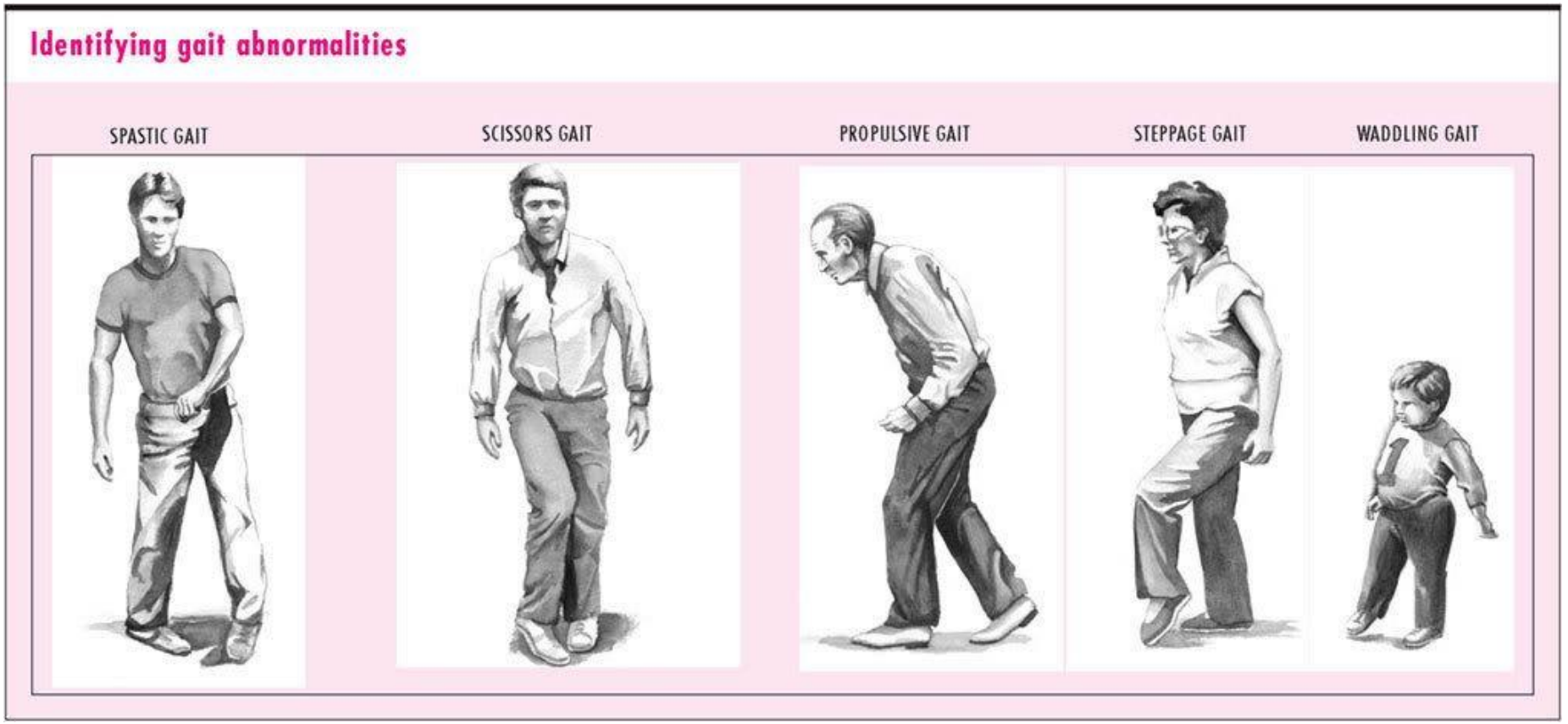
Pathologic Gait



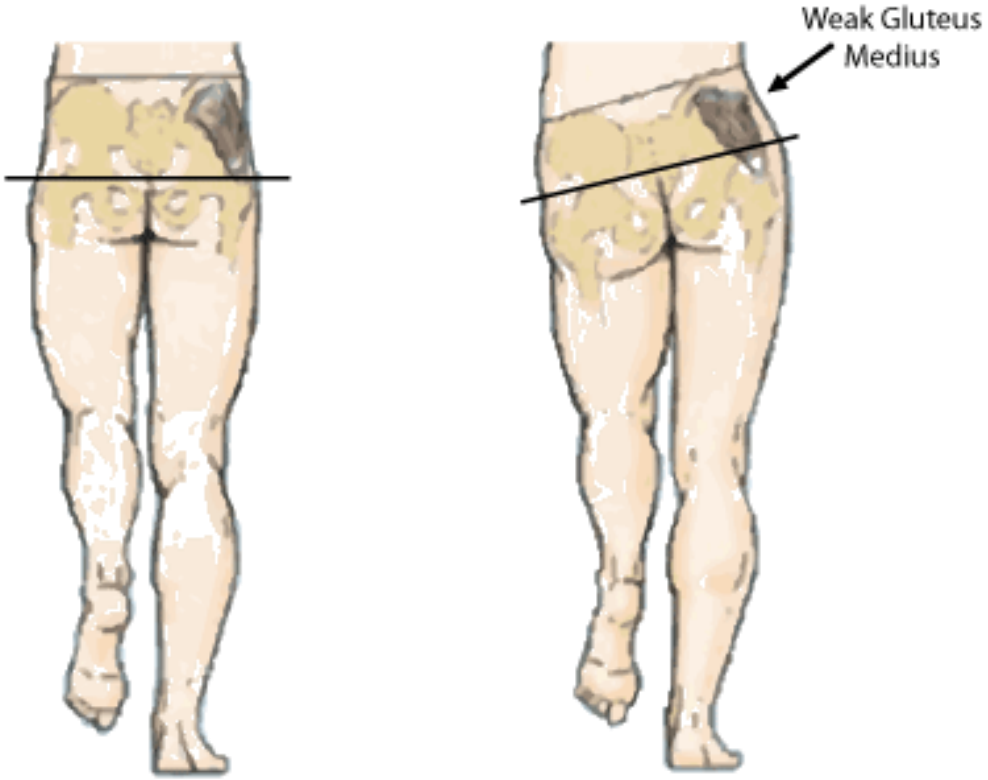
Pathologic Gait



Pathologic Gait



Pathologic Gait



Normal

Trendelenburg Sign

Drop of pelvis when lifting leg opposite to weak gluteus medius

Abductor Lurch vs Trendelenberg

- https://vimeo.com/187498754

The quick and dirty gait exam

- A great way to get a lot of useful information
- Fun for the child – eases fears, builds trust
- What are we looking at?
  - Walking
  - Running
  - Balance and coordination
  - The rest of the child.

How do I do it?

1. Long unobstructed hallway with low traffic
2. Make sure you can see the knee caps and feet
   - Toddlers – diaper
   - Kids and Teens – shorts that show knees
3. Three passes:
   1. walk away and towards,
   2. tip toe-walking and heel walking
   3. run away and towards
4. Take a video if possible
   - Ability to review later
   - Slo-Mo

What am I looking at?

1. General observation: Normal or Not normal
2. General Gait Pattern
    a. Reciprocal
    b. Antalgic
    c. Waddling
    d. Scissor
    e. Steppage
    f. Etc…

3. Torso/Hips:

- Shoulder height
- Abductor lurch, trendelenberg
- Pelvic retraction, tilt

4. Knees:

- Patellar progression angle
- Cross over/scissoring
- Medial or lateral instability
- Full extension in stance phase?

5. Feet/Ankles:

- Foot contact pattern: heel-toe, toe-toe, early heel rise
- Foot progression angle
- Great toe push off
- Varus/valgus ankle position
- Arch shape with full foot contact
- Dynamic supination

6. Running:

- Accentuation or improvement of prior findings
- Upper body posturing

On Table Exam

- Neuro:
  - DTRs
  - Abdominal reflexes
  - Proprioception
- MSK:
  - Strength:
    - Functional: squat to stand, climb on and off bed
    - Directed muscle testing: pay attention to limb position.
  - Sensation

Pediatric Normals

- Toddler 1-3 years
  - Genu varum
  - Wide stance
  - Intoeing:
    - femoral anteversion,
    - tibial torsion
    - Metatarsus adductus
  - Out-toeing:
    - Flexible flat foot

Pediatric Normals

- Young Child 3-5 years
  - Genu Valgum
  - Narrow Stance
  - Intoeing
    - Same as younger group
  - Out-toeing
    - Same as younger group

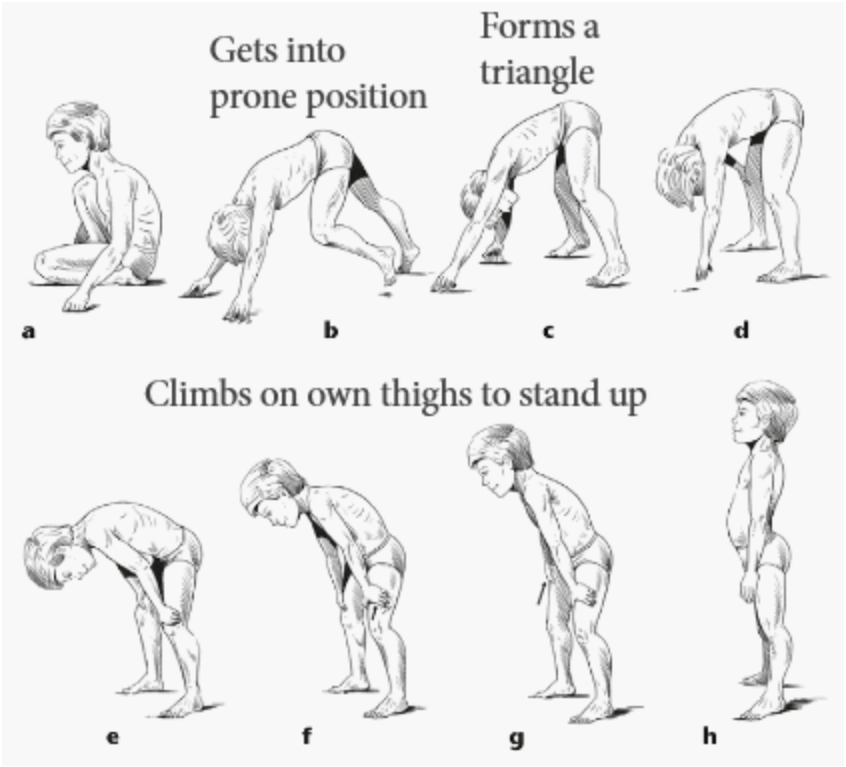
Pediatric Normals

- School Age 6-10
  - Neutral alignment
  - Narrow stance
  - Normal rotation
  - Restoration of arch

Red Flags

- Abnormal reflexes – neurologic conditions, spinal tumors
- Behavioral/cognitive developmental issues – ASD
- Increased tone, UE posturing – Cerebral Palsy
- Gower's Sign – Muscular dystrophy

Gower's Sign


Gets into prone position
Forms a triangle
a
b
c
d
Climbs on own thighs to stand up
e
f
g
h

- Progressive deformity - Blount's, Rickets, growth arrest, tethered cord, CMT
- Limp – SCFE, Perthes, DDH, LLD, instability
- Hip/Knee Pain – SCFE, Perthes, dysplasia, varus/valgus, torsion
- Foot Pain – tarsal coalition, stress fractures
- Weakness – neurologic condition, muscular dystrophy

Summary

- Know the normals
- Get a good history:
  - Developmental
  - Trauma?
  - Family history
- Do a thorough physical exam:
  - Reflexes
  - Strength
  - Sensation
- Pain, progression, abnormal: REFER
  - Neurology, Neurosurgery, Genetics, Endocrine