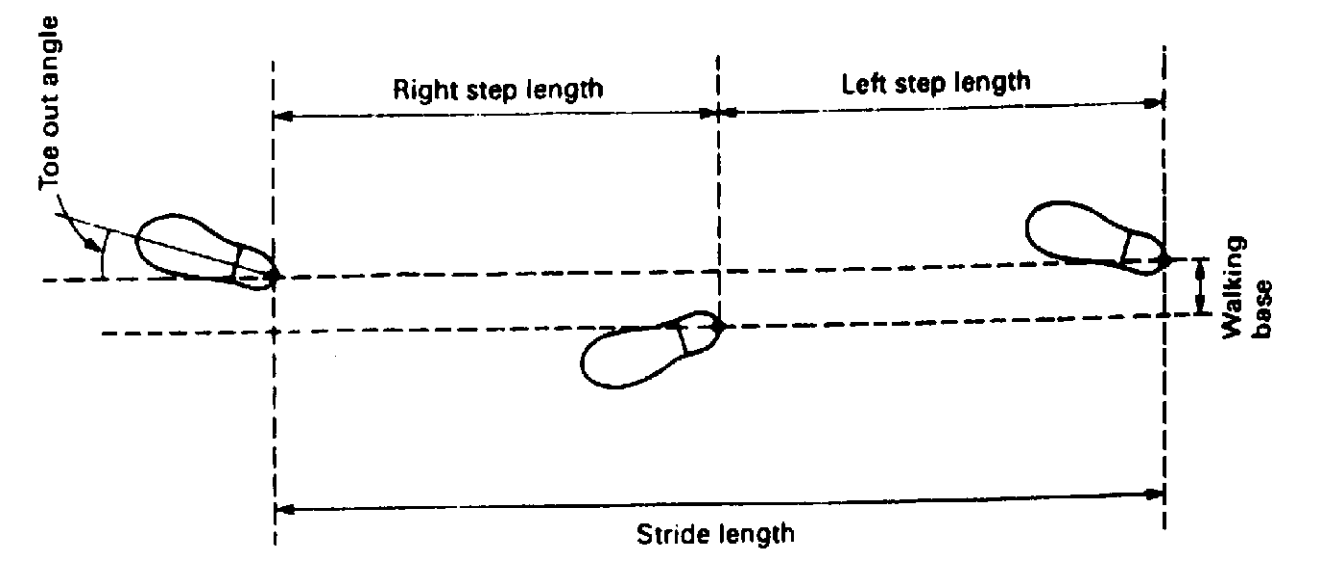
THE MECHANISMS OF GAIT.

By Jeffery Porter, SPTA.

WHAT IS GAIT

- What is gait?
- Sequence of functions of one limb.
- Begins when specified foot hits ground.
- Ends with subsequent floor contact of same foot.

GAIT CYCLE


Toe out angle
Right step length
Left step length
Walking base
Stride length

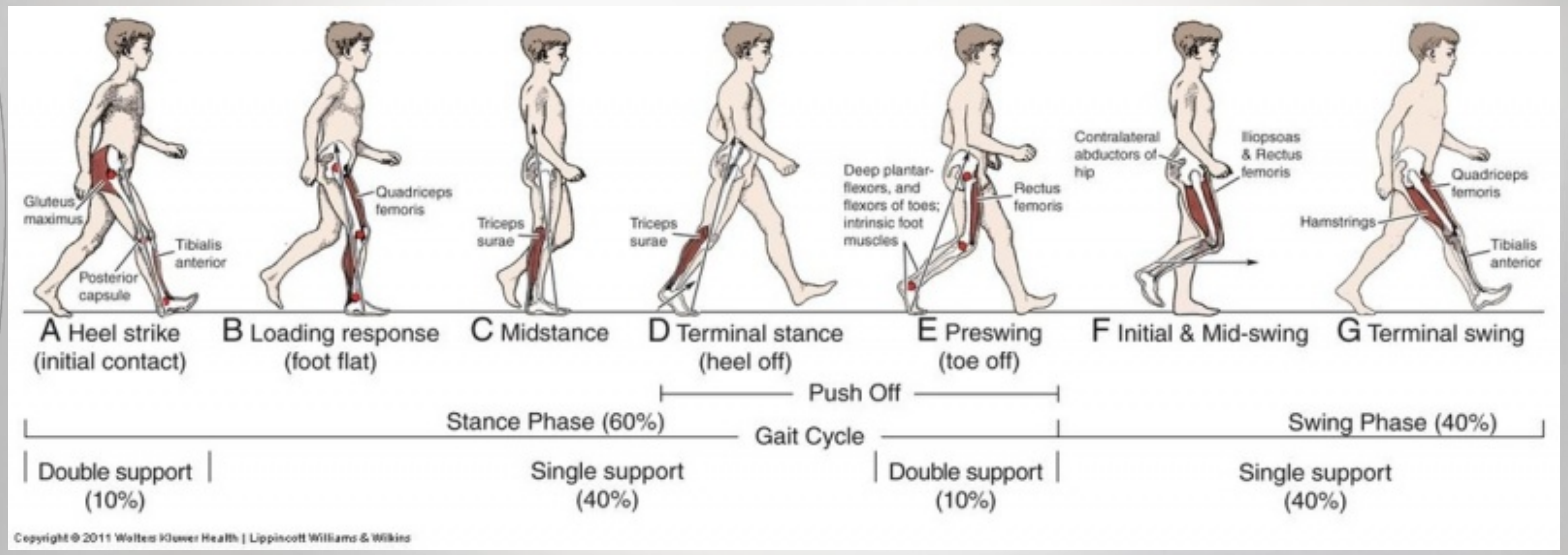
STANCE PHASE

- **Heel contact –** When heel initially touches the floor.
- **Flat foot** – Entire foot is in contact with ground.
- **Mid stance** – Body weight shifted over grounded foot.
- **Heel-off** – Plantar flexors begin "pushing off" to propel body.
- **Toe-off** – Last of stance phase, considered "Pre-swing".

SWING PHASE

- **Early swing –** (Acceleration phase) Foot begins dorsiflexion allowing clearance as it advances.
- **Mid-swing** – Foot overtakes contralateral limb in stance.
- **Terminal swing** – (Deceleration) Limb begins slowing down and preparing for heel contact

GAIT CYCLE


Gluteus maximus
Tibialis anterior
Posterior capsule
Quadriceps femoris
Triceps surae
Triceps surae
Deep plantar-flexors, and flexors of toes; intrinsic foot muscles
Rectus femoris
Contralateral abductors of hip
Iliopsoas & Rectus femoris
Hamstrings
Quadriceps femoris
Tibialis anterior
A Heel strike (initial contact)
B Loading response (foot flat)
C Midstance
D Terminal stance (heel off)
E Preswing (toe off)
F Initial & Mid-swing
G Terminal swing
Push Off
Stance Phase (60%)
Gait Cycle
Swing Phase (40%)
Double support (10%)
Single support (40%)
Double support (10%)
Single support (40%)
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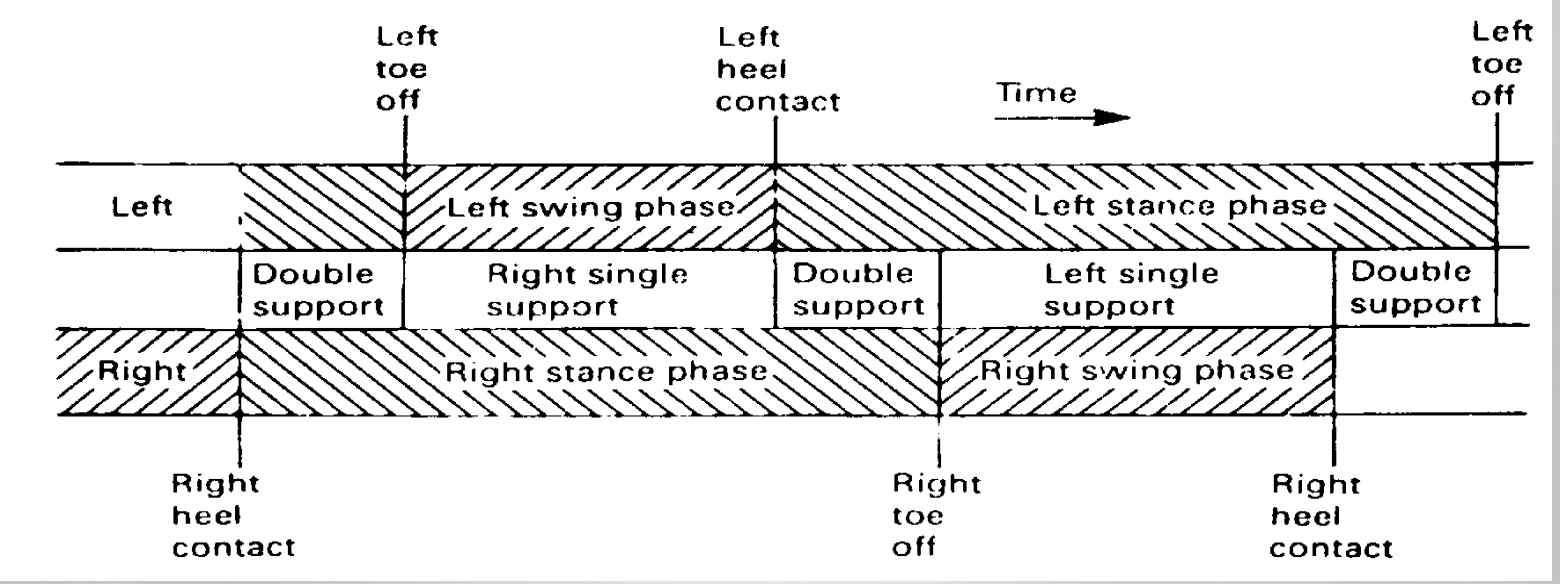
GAIT CYCLE

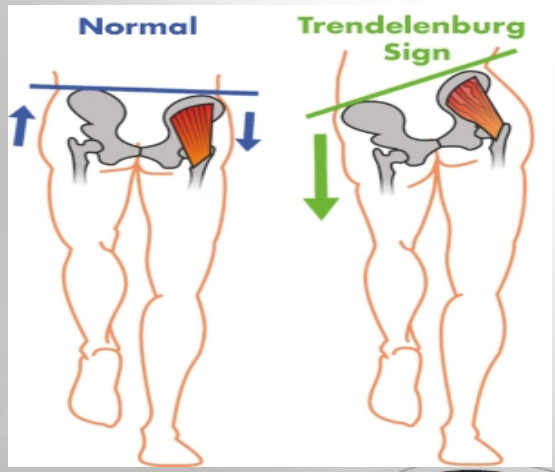
- **Single support –** Refers to the phase in the gait cycle in which only one foot is on the ground.
- **Double support** – Both feet are on the ground, low center of gravity, most balance during these phases.
- **Various speeds:**
  - **Walking at higher pace** – Decreased Stance and Double support phases, and increased swing phase.
  - **Running** – No double support phase, instead double swing.

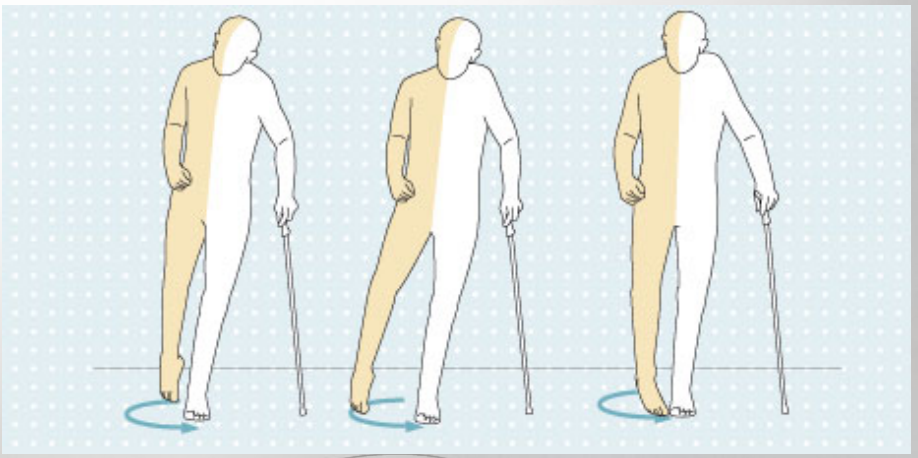
GAIT CYCLE


Left toe off
Left heel contact
Time
Left toe off
Left
Left swing phase
Left stance phase
Double support
Right single support
Double support
Left single support
Double support
Right
Right stance phase
Right swing phase
Right heel contact
Right toe off
Right heel contact

PATHOLOGIES

- Several pathologies affect gait:
  - Weaknesses or Spasticity in certain groups.
  - Neurological pathways interrupted.





GAIT SNOWFLAKES

- 1 gait deviation can be caused by many pathologies.
  - Spasticity, weakness, compensation, pain.
- If one person presents with a abnormality, there could be several reasons as to why.

FOOT SLAP

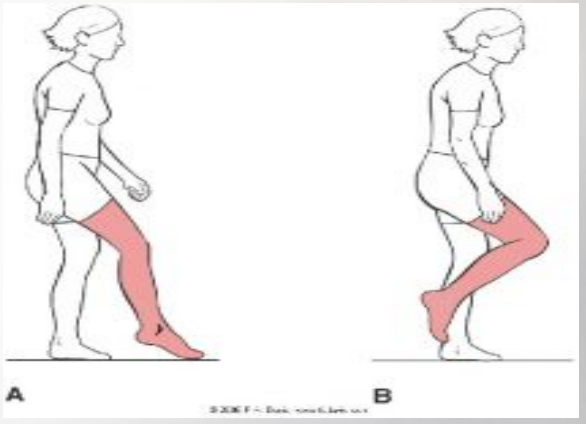
❖ This type of gait is usually seen in patient with damage to deep peroneal nerve, hemiplegia or peripheral neuropathy.

- Signs are: on heel contact the foot quickly drops into plantarflexion.

❖ Strengthening dorsiflexors or wearing an AFO (Ankle-Foot Orthosis) may assist patients with this pattern.

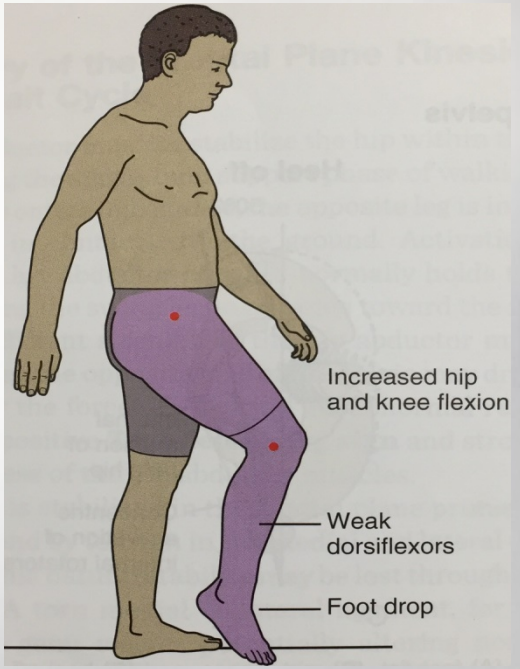
VAULTING

- Presented as "tip-toe" walking.
  - Caused by lack of clearance of contralateral stance leg.
  - May also be due to spasticity.
- If spastic:
  - Stretching tight muscles and strengthening their antagonistic muscles may help.
- If Leg-length issue:
  - Shoe-lift orthotic may be beneficial.



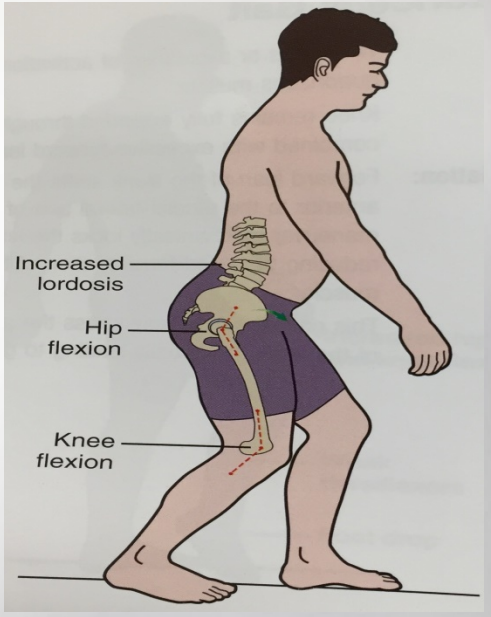
HIGH STEP GAIT

- Can result from weakness in the dorsiflexor muscles.
  - During swing excessive hip flexion used to clear swing leg.
- May also result from neuropathy, from inability to feel.
- Strengthening dorsiflexors or Orthotic (Ankle-Foot-Orthosis) may help reduce these patterns.



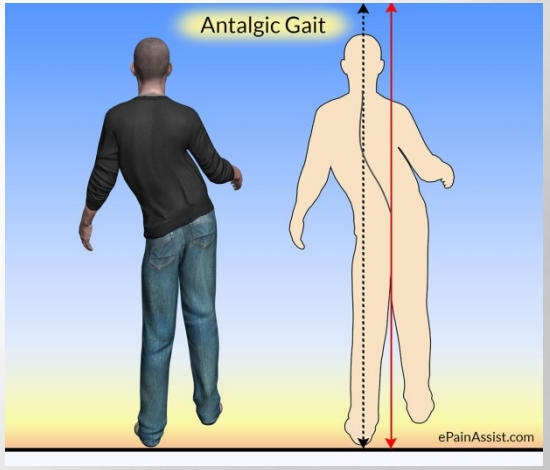
CONTRACTURES

- Hip and knee contractures/spasticity: (Aka crouched gait)
  - Lumbar lordosis compensation during gait.
  - Reduced stride length due to shortened lower extremity.
- Possible stretching affected/strengthening antagonistic muscles may help reduce this pattern.



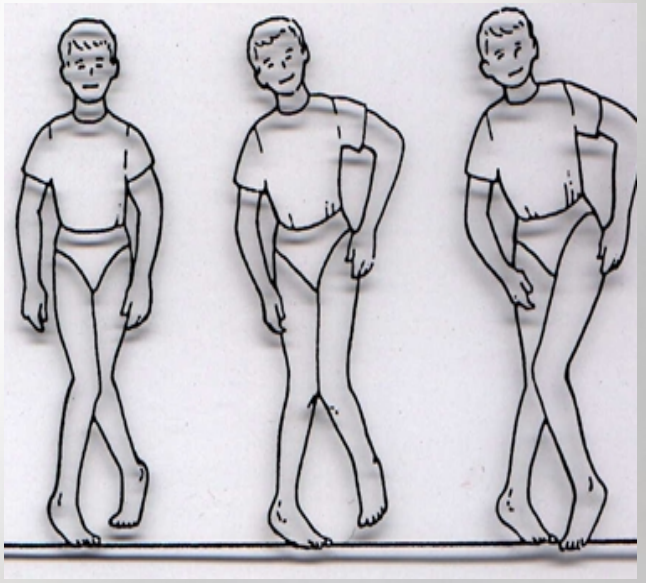
ANTALGIC GAIT

- One foot/leg is in pain and patient does not want to stand on it very long.
  - Stance phase on affected LE is reduce and may be abducted.
  - Swing phase on contralateral leg is increased.
- Find the root of the problem; what causes the pain. Once address this pattern may resolve itself.



SCISSORS GAIT

- Caused by spasticity of adductor muscles.
  - Obvious during swing phase due to leg being unweighted.
  - Compensatory patterns may be evident by trunk leaning over stance leg to counter balance.
- Find the root of the spasticity.
  - If musculoskeletal, stretching may be beneficial.
  - If central nervous involvement orthotics may assist with this gait.

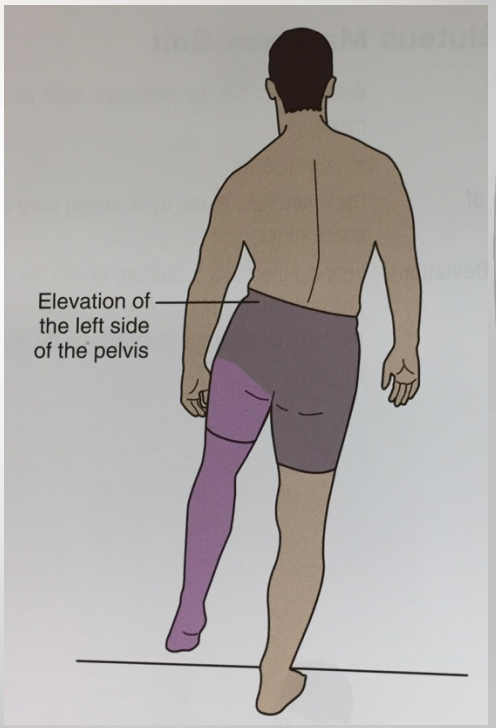


LEG LENGTH DISCREPANCY

- One leg longer than the other.
  - May be congenital, from previous injuries.
- Compensatory patterns:
  - Shorter leg:
    - May planterflex during stance phase to clear longer leg. (presents as equine gait).
    - Pelvis may drop during swing phase.
  - Longer leg:
    - May circumduct during swing phase to clear ground.
- Orthotics may help if the LLD is substantial.

HIP HIKING

- Swing leg is unable to shorten.
  - Due to possible weakness in hip flexors, spasticity in hip extensors, or wearing a brace.
  - Swing leg's hip will elevate to create clearance for swing leg.
  - May also present with compensation of lateral flexion of trunk towards stance leg side.
- Possible strengthening to weak hip flexors, or stretching and inhibitory therapy to hip extensors.

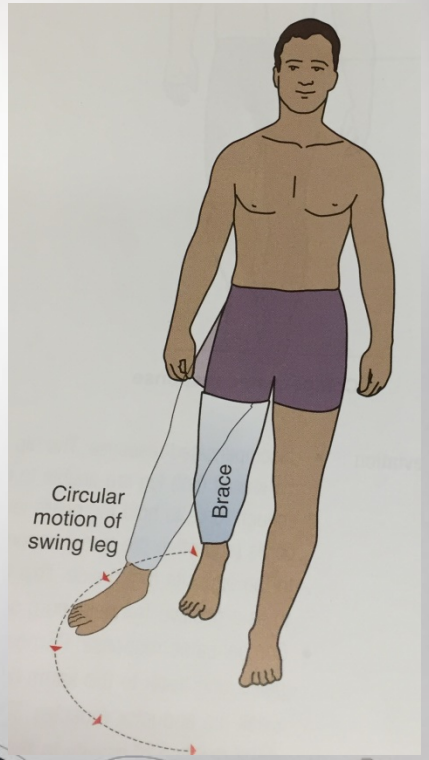


CIRCUMDUCTION

❖ Similar to hip hiking gait, the swing leg lacks the ability to shorten.

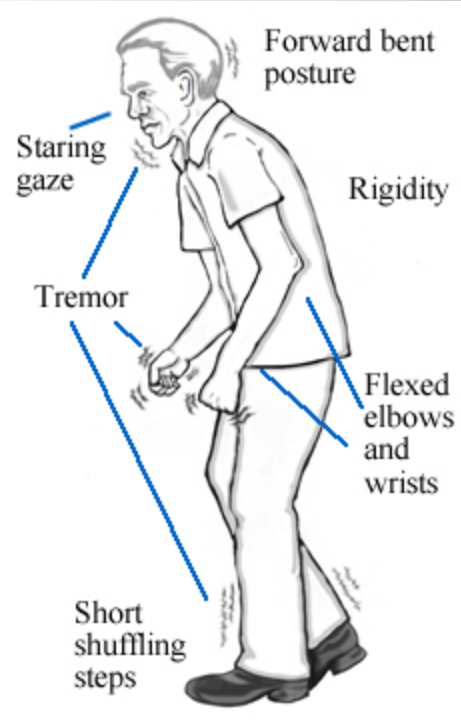
- Instead of pelvic elevation, the leg advances in a semi-circular pattern to create clearance for the longer leg.
- Places more tension on the muscles that cause this semi-circular motion, the abductors.

❖ What is causing the leg to insufficiently function? Is it due to leg-length discrepancy, brace, weakness, or spasticity. Find the root and address it.



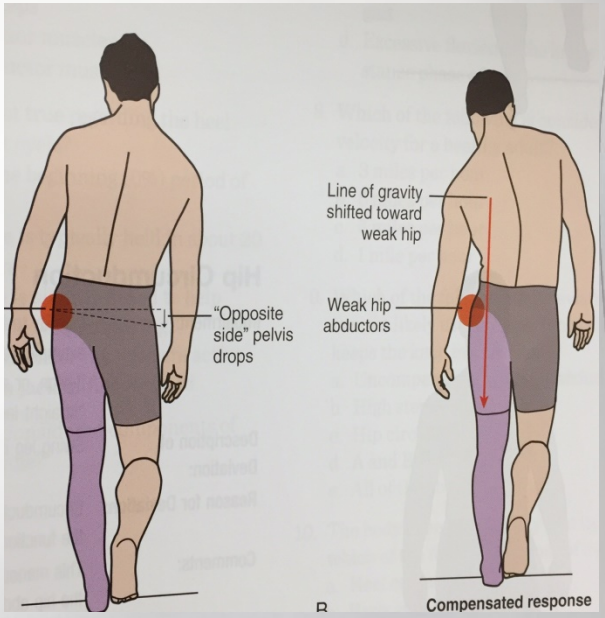
PARKINSONIAN GAIT

- Body is bend forward, with lack of reciprocal arm swing.
  - Patient may have trouble initiating the gait, but once started speed increases and may difficulty stopping.
  - Flat footed gait with weight shifted anteriorly.
  - Shortened stride (small steps)
    - This can become a major safety issue, patients unable to clear objects or feet may be more prone to falls.
- Appears as if patient's feet are trying to catch up with the forward trunk posture.



TRENDELENBURG

- Weakness in hip abductor muscles.
  - During stance phase the pelvis must be held equal, the hip abductors on the stance leg cannot maintain the isometric contraction.
  - Due to this, the pelvis "drops" to the opposite side.
  - Compensation may be seen by patient leaning to the side of the weak abductor muscles.
- Strengthening of the hip abductors may be helpful to reduce the extremes of this gait.



QUESTIONS?

- Thank you all so much for your time!

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