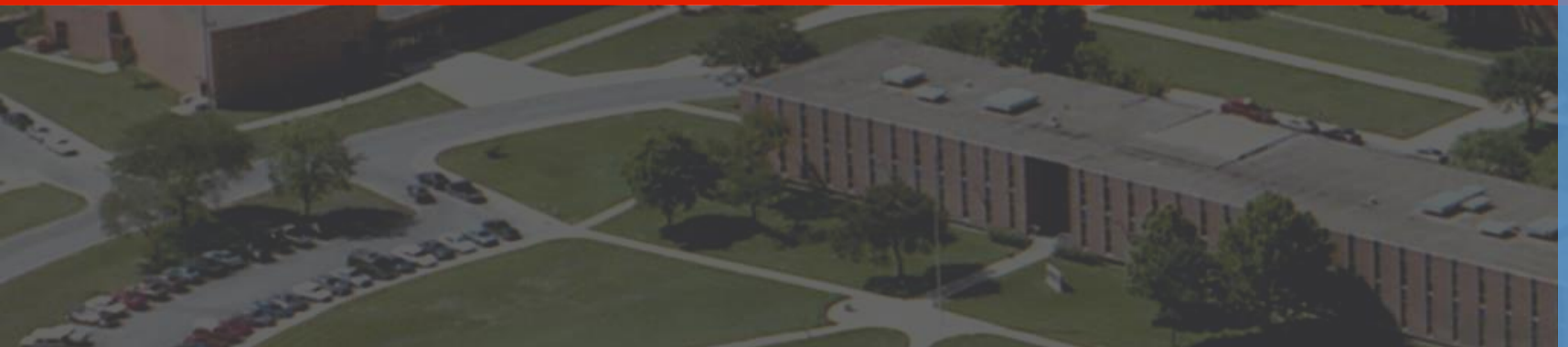
School *of* Osteopathic Medicine

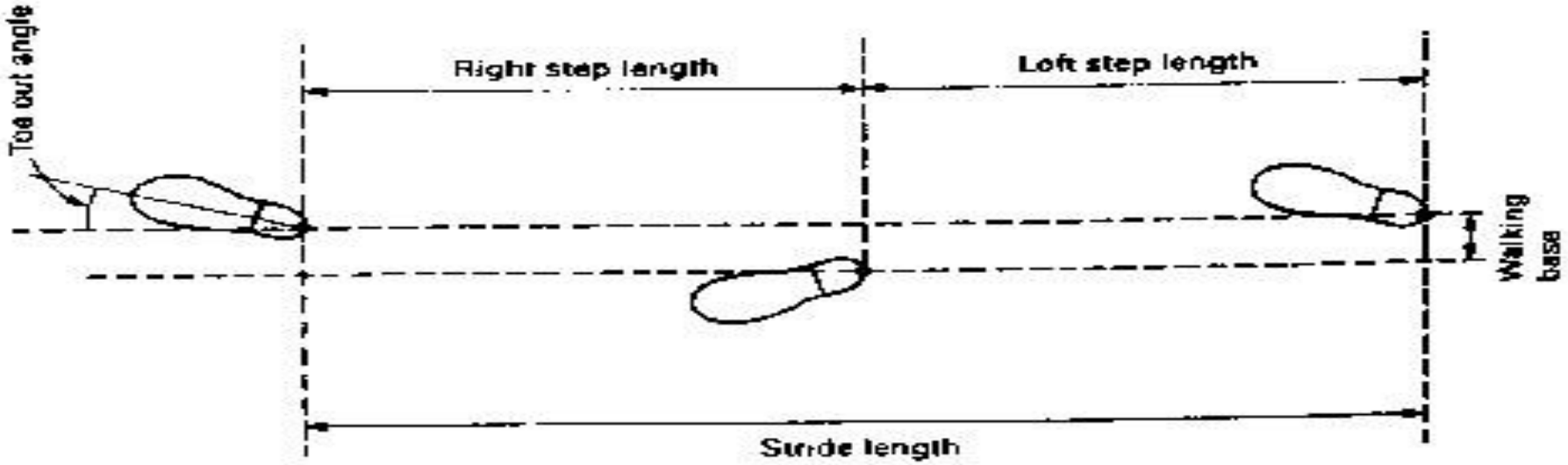
Clinical Gait Assessment

Raul Marin MD



Disclosures

- I have no actual or potential conflict of interest in relation to this program/presentation



Step Length:

1. Distance btw corresponding successive points of heel contact of the feet.
2. Symmetric

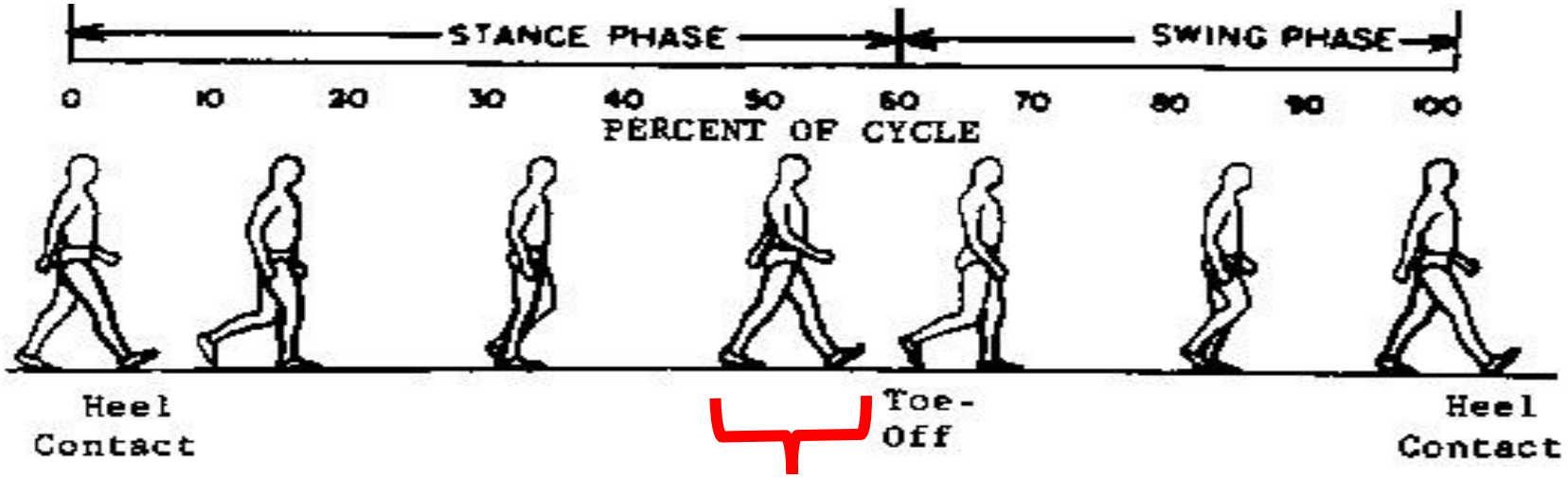
Stride Length:

1. Distance btw successive points of heel contact of the same foot
2. two-step lengths = one stride length

Walking base (stride width):

1. Side to side distance between each successive stepping foot

UNIVERSITY OF THE INCARNATE WORD
SCHOOL of OSTEOPATHIC MEDICINE



Double Support 10%

Gait cycle has two phases: Stance & Swing

Stance:

Old descriptions	New descriptions
1. Heel contact	Initial contact
2. Foot flat	Loading response
3. Mid stance	Mid stance
4. Heel off	Terminal stance
5. Toe off	Pre-swing

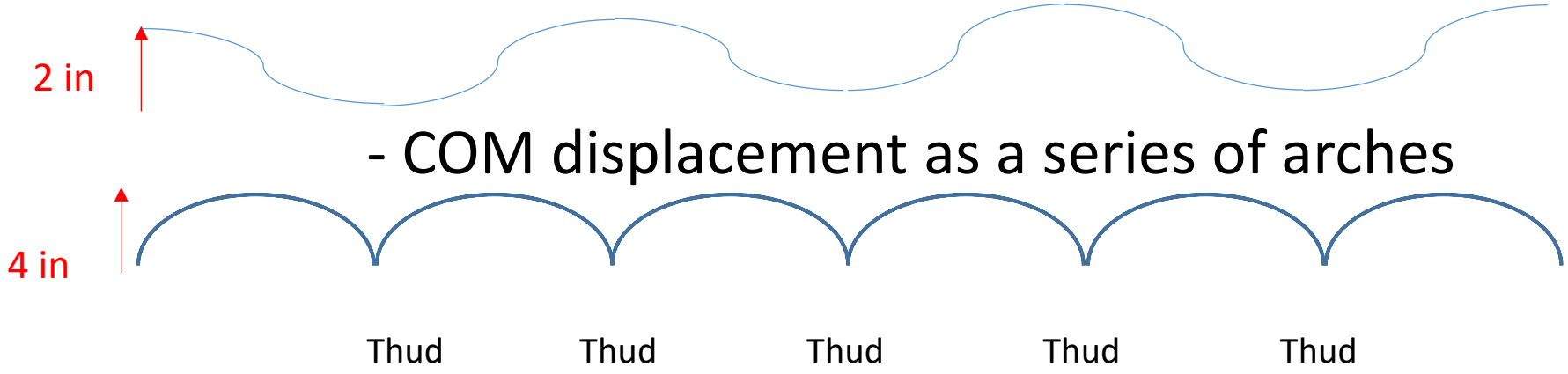
Swing: acceleration – mid swing - deceleration

UNIVERSITY OF THE INCARNATE WORD
SCHOOL *of* OSTEOPATHIC MEDICINE

Center of Mass (COM)

Center of Mass (COM)

- On front of S2
- Least energy use: - COM displacement as a sine wave



- Goal is to minimize movement of COM to reduce energy demands.

The 6 Determinants of Gait

- Determinants of gait:
    1. Pelvic rotation
    2. Pelvic tilt
    3. Knee flexion in stance
    4. Foot/Ankle plantar flexion at initial contact
    5. Foot/Ankle plantar flexion at pre-swing
    6. Lateral displacement of the body

- The above lower muscle contraction power to approximately 20-25% of maximum muscle strength

First Determinant of Gait

#1: Knee Flexion In Stance Phase

- 20 degree of flexion initial contact → mid stance
- ↓ length of weight bearing leg → ↓raise of the CG by ***1 inch***

Second Determinant of Gait

#2: Pelvic Tilt

- 5 degree drop of the non-weight bearing pelvis
- ↓the height of the CG raise during stance phase by ***½ inch***

Third Determinant of Gait

#3: Pelvic Rotation

- Occurs at double support and rotates 8 degrees
- ↓ amount of hip flexion & extension required to maintain a longer step length without lowering the CG
- Raises the low point of the curve by ***½ inch***

Fourth Determinant of Gait

#4: Ankle-Foot at Initial Contact

- ***Plantar flexion*** at initial contact ***smoothens the curve*** of the CG in space.

- Eliminates abrupt transitions which waste energy and are detrimental to joints

Fifth Determinant of Gait

#5: Ankle-Foot at Pre-Swing

- ***Plantar flexion*** at pre-swing lengthens the weight bearing limb

- ↓ drop of the CG during the double stance (transition from one leg to the other leg)

Sixth Determinant of Gait

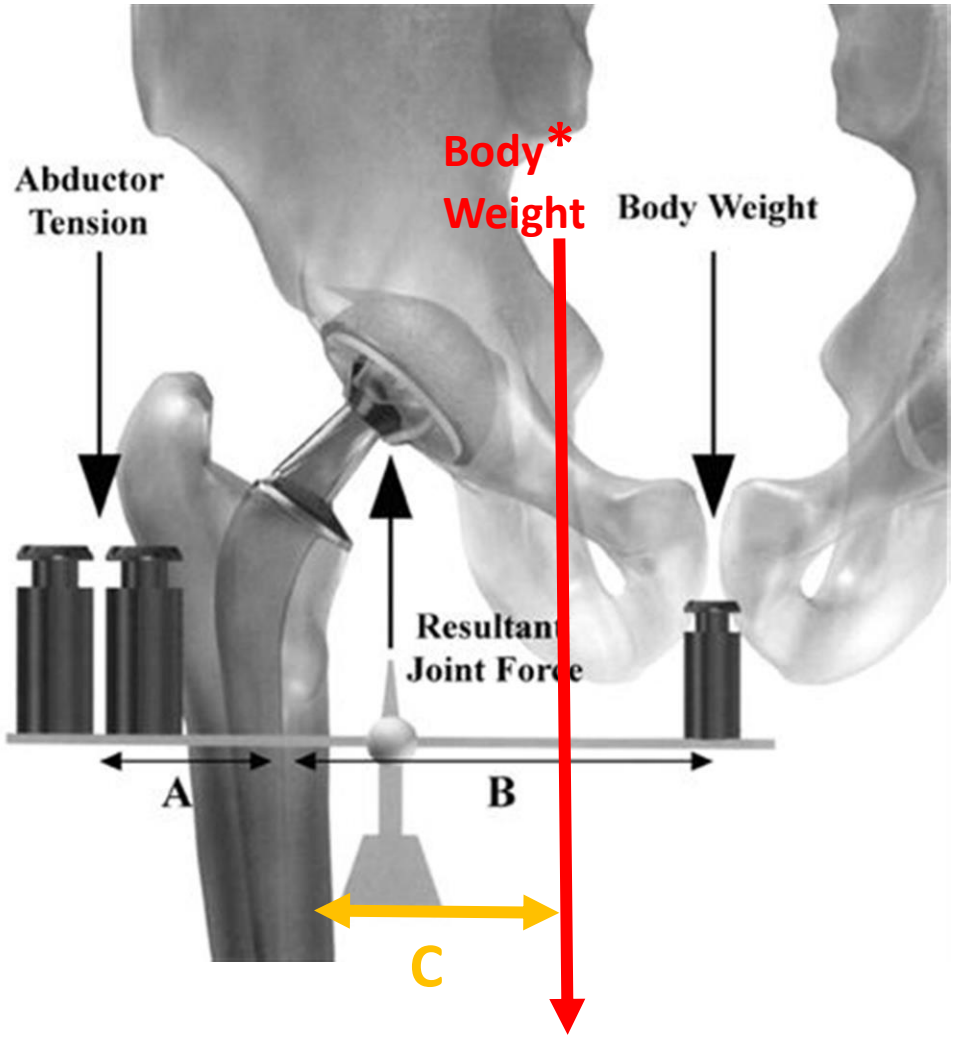
#6: Side to Side Displacement of Body

- Brings the CG nearly over (as close as possible) the hip joint thus decreasing the abductor muscle forces required to balance the pelvis in space thus leading to energy conservation

Biomechanics of Standing

Abnormal Gait

Hip & Cane Biomechanics

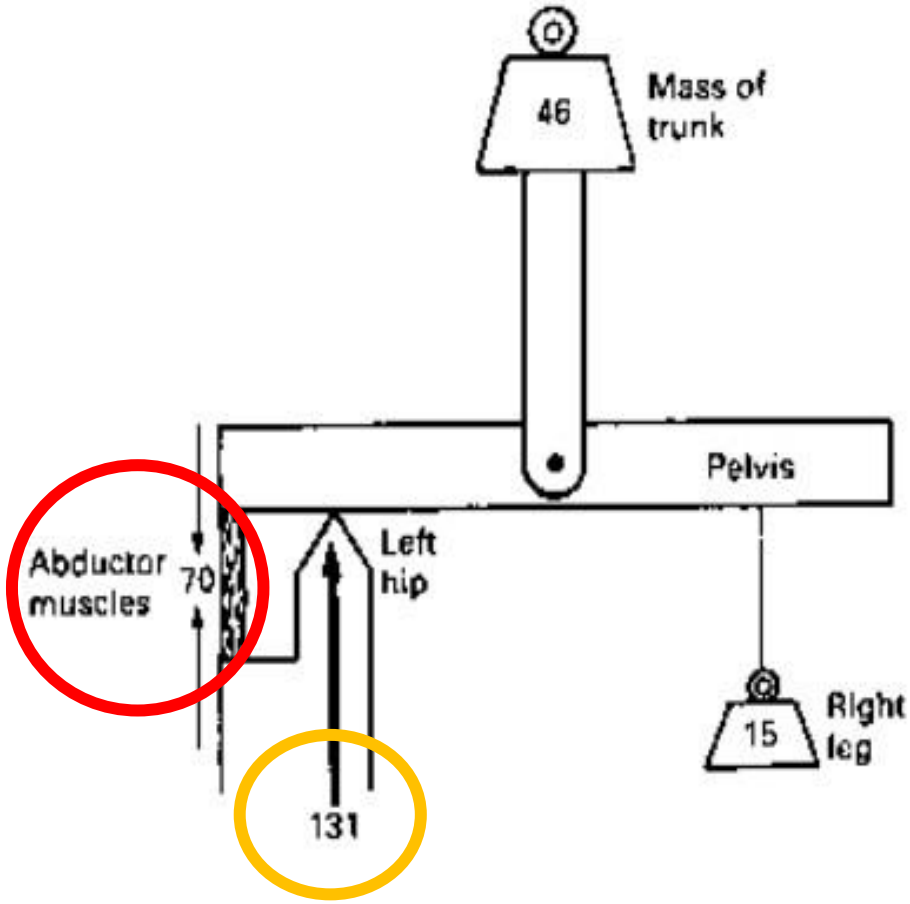


*Side-to-Side shift of CG closer to hip joint

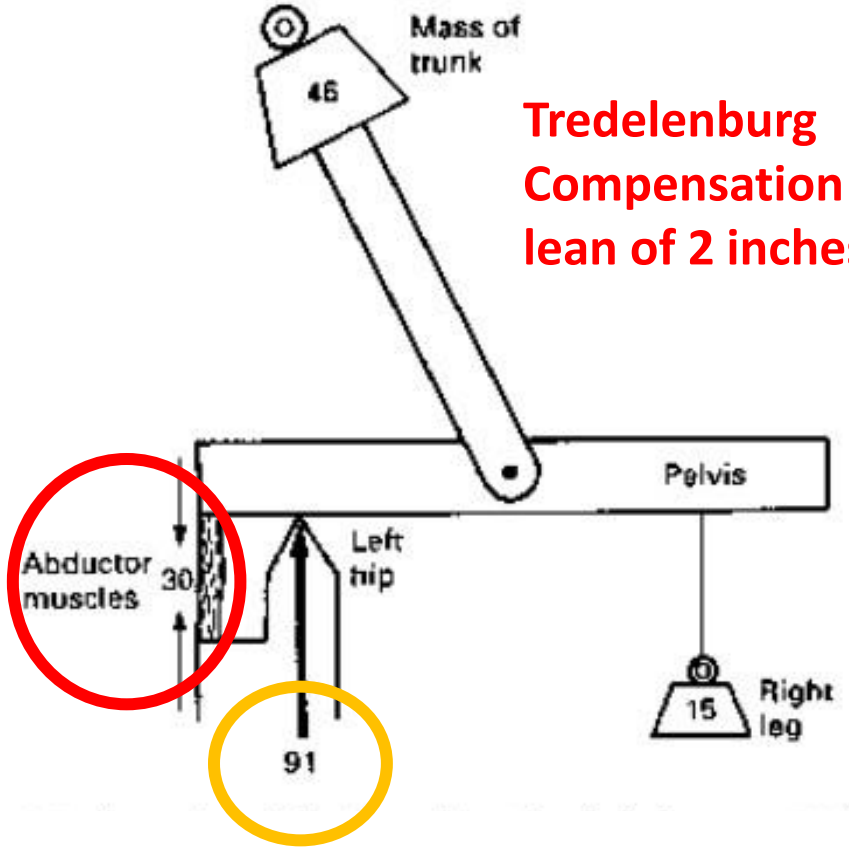
B = 2 inches

C = ½ inch

UNIVERSITY OF THE INCARNATE WORD
SCHOOL of OSTEOPATHIC MEDICINE



Single leg stance LLE requires 70kg abductor force



Tredelenburg Compensation (trunk lean of 2 inches)

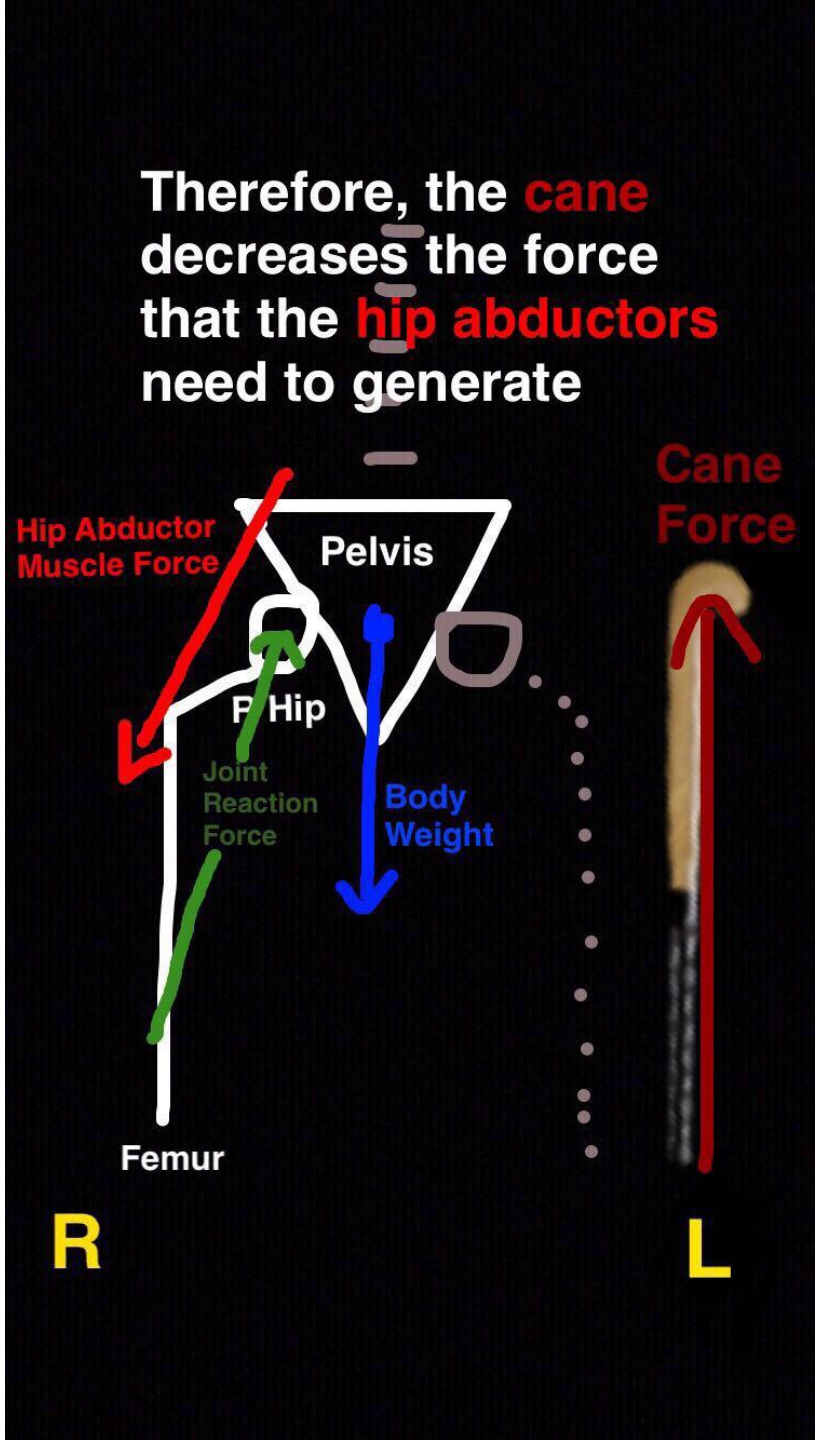
Compensation reduces abductor force to 30kg

UNIVERSITY OF THE INCARNATE WORD
SCHOOL of OSTEOPATHIC MEDICINE

Don't Throw Away the Cane!

- Patient with painful right hip who weighs 160 pounds.

- By Placing 20% of body weight thru a cane (32 pounds) the hip abductor force is reduced so as to decrease forces at the hip joint by 40% (64 pounds).



Just for Fun: Funny Walking Patterns

- https://youtu.be/sHyKIK-gbsk