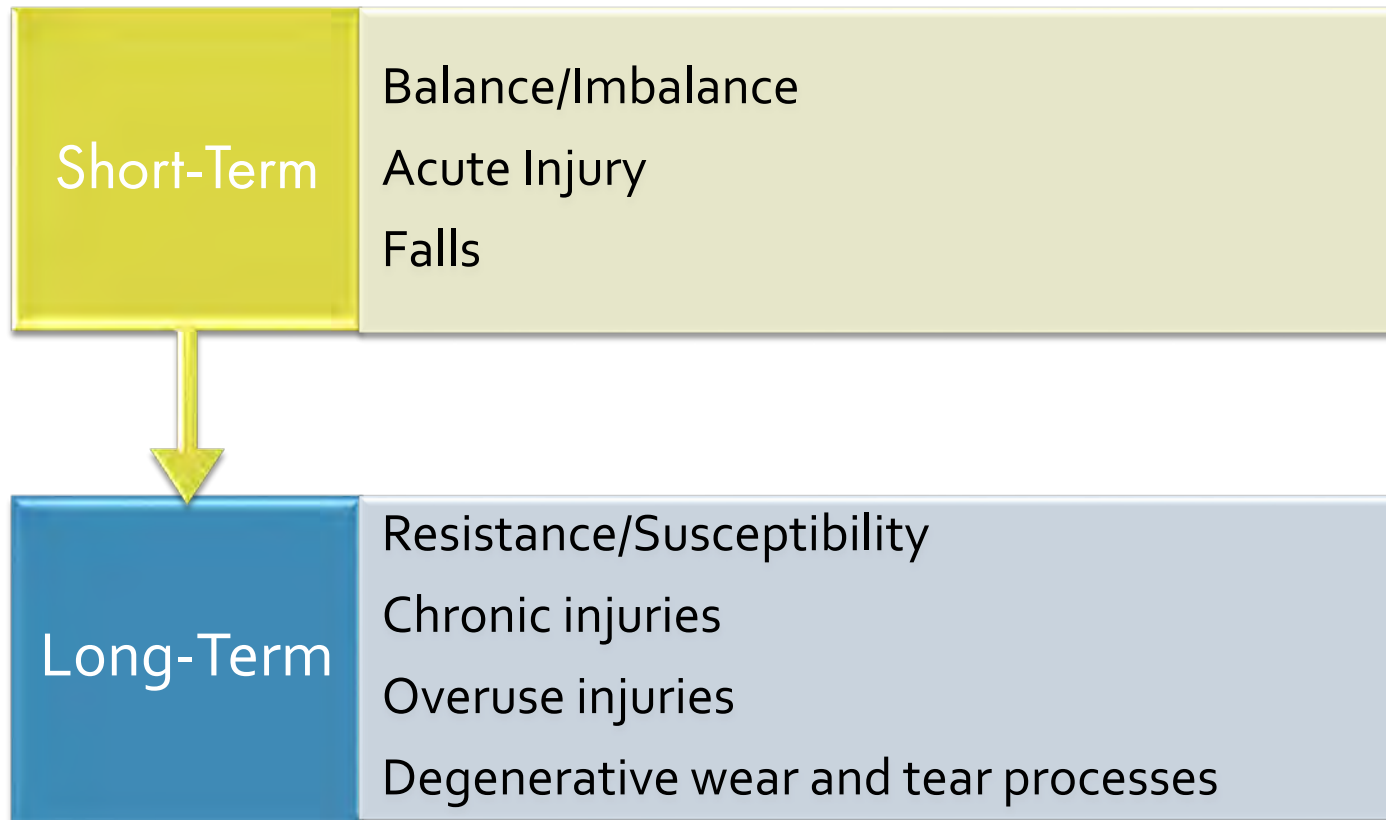
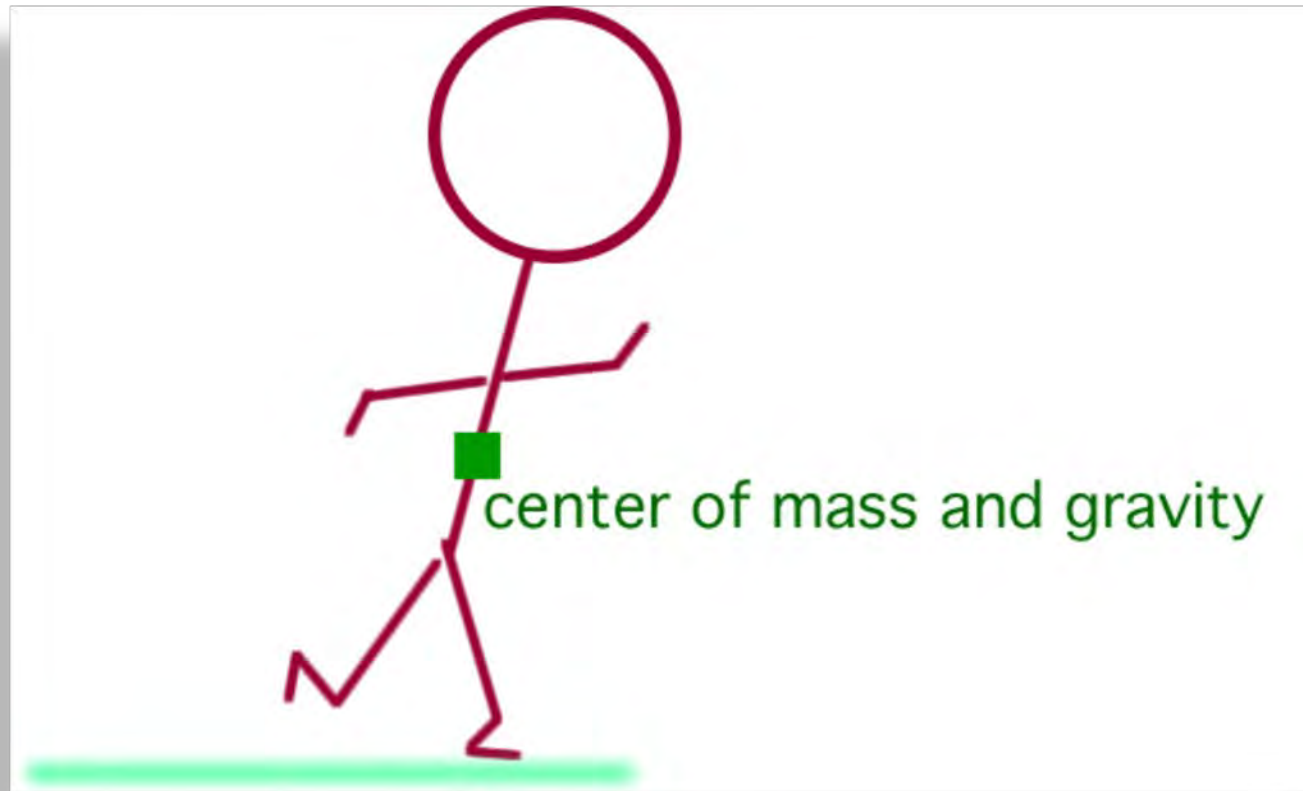


Safety/Injury



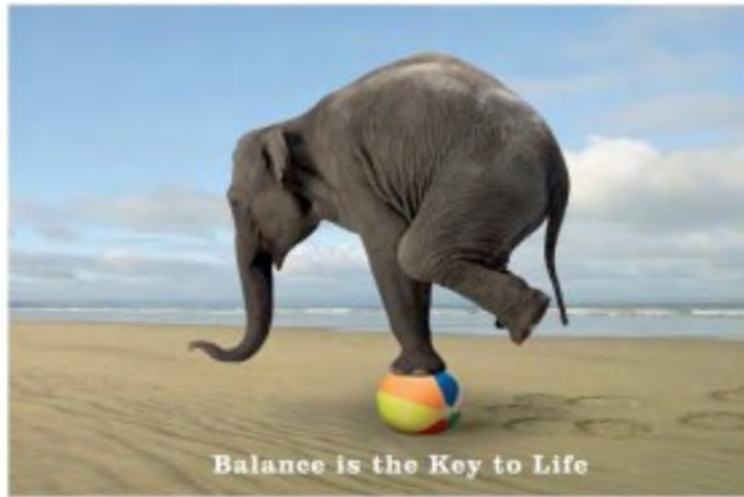
- **Safety/Injury**
 - Balance/Imbalance-Falls
 - Resistance/Susceptibility
 - Forces: Accelerations/Decelerations
 - Joints:
 - Stability/Instability
 - Traction/Impingement
 - Muscles: Strength/Weakness
- **Energy Efficiency**
 - Stride length/Step cadence
 - Braking
 - Gliding
 - Bounce/Elasticity
 - Resonance
 - Muscle work
- **Performance**
- **Dynamic/Static Foot**
- **Posture**
- **Adaptation**

Center of Mass - COM



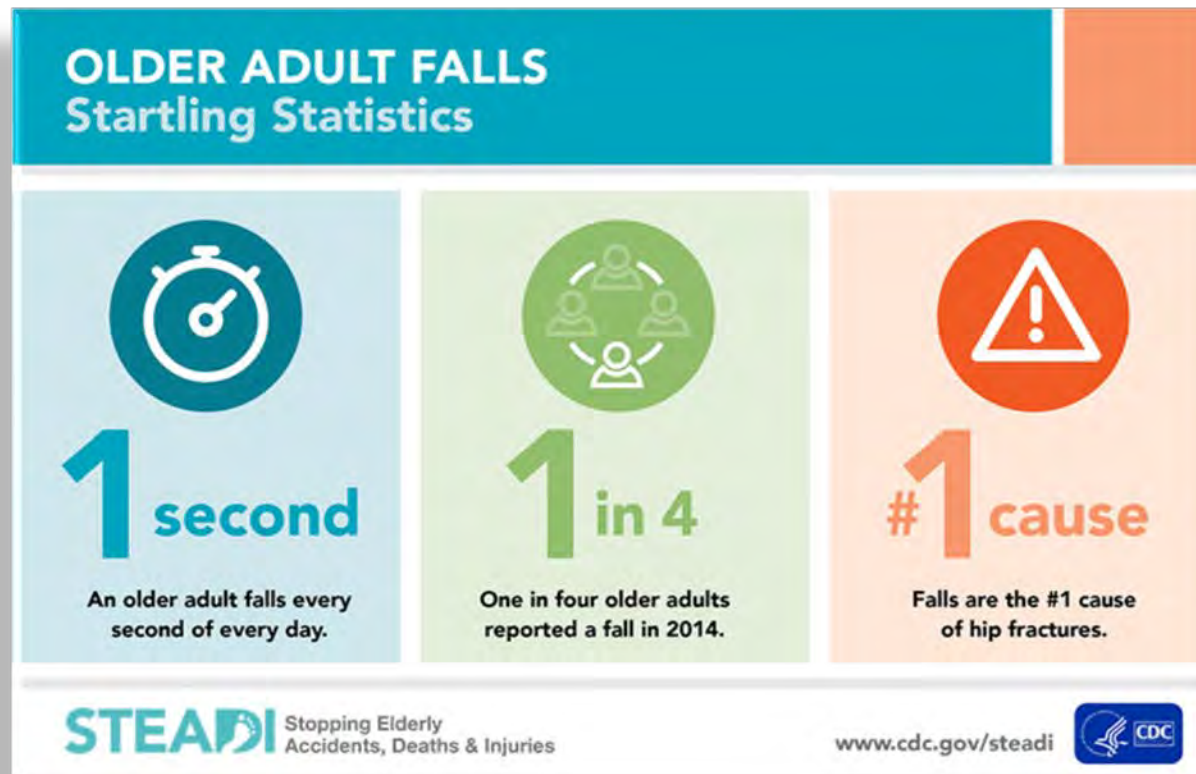
Safety/Injury

Balance/Imbalance-Falls

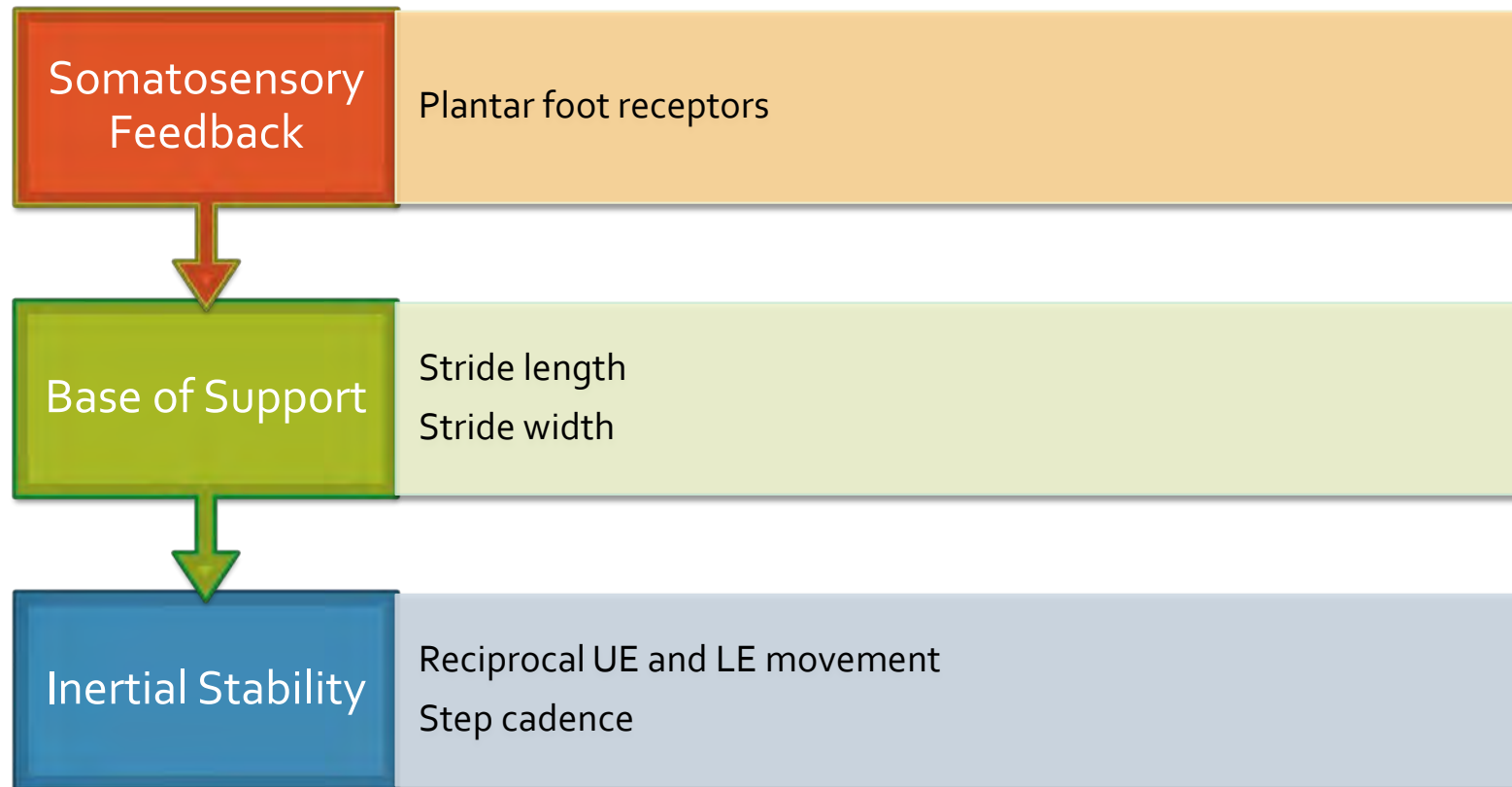


- **Safety/Injury**
 - Balance/Imbalance-Falls
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Safety – Balance/Imbalance

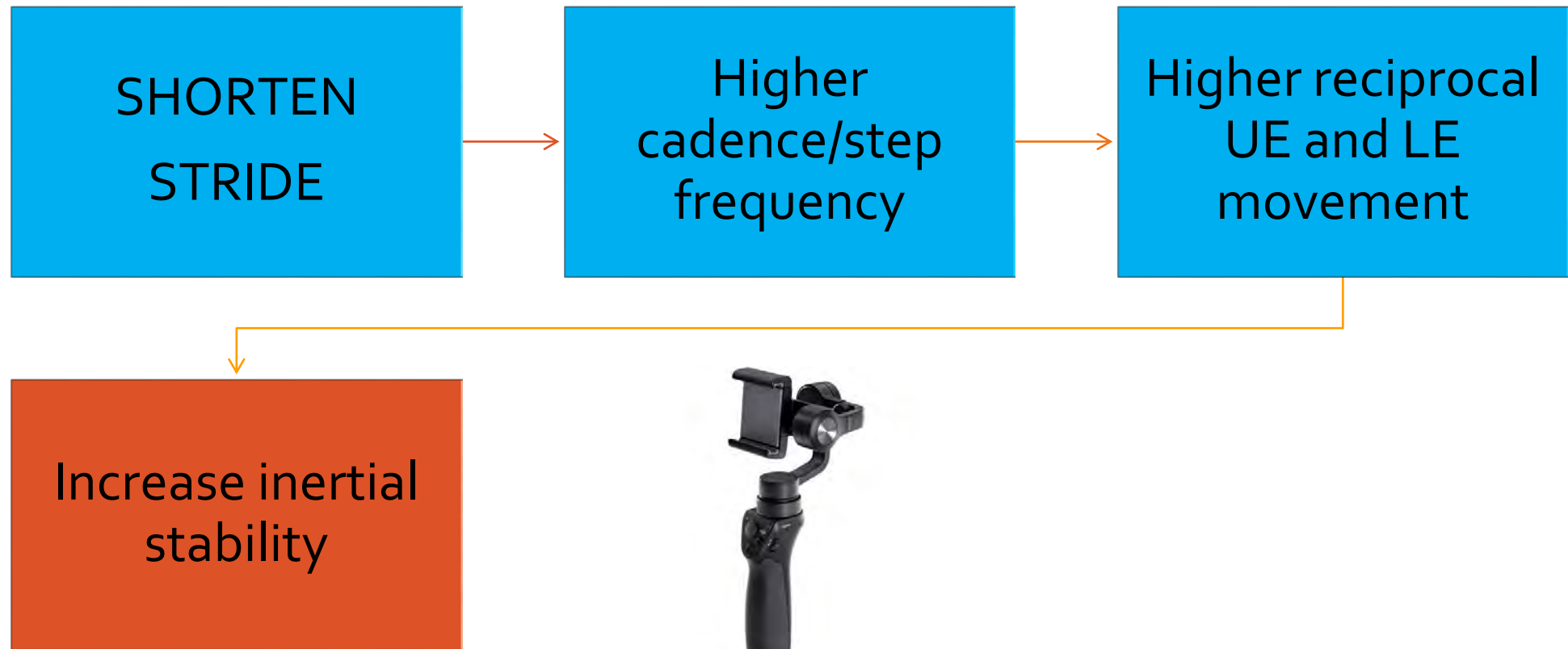


Walking Balance



Inertial Stability

Key to Walking Balance



Walking Balance

Inertial Stability

(DW/HBW)



(HTW)

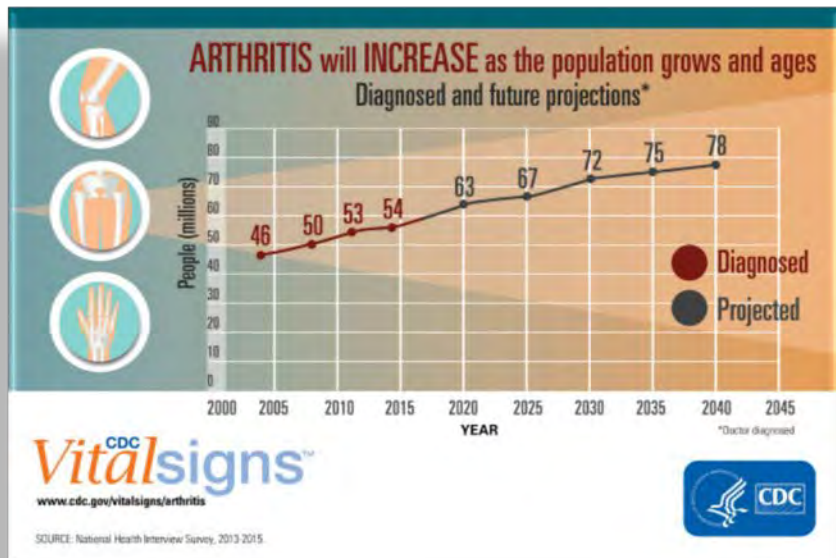


Step Cadence Dependent

- **Balance** - DW/HBW
 - Higher step cadence
 - **More reciprocal UE & LE movement**
 - **Increased inertial stability**
- **Imbalance** - HTW
 - Lower step cadence
 - **Less reciprocal UE & LE movement**
 - **Decreased inertial stability**

Safety/Injury

Resistance/Susceptibility



- **Safety/Injury**
 - Balance/Imbalance-Falls
 - **Resistance/Susceptibility**
 - Forces: Accelerations/Decelerations
 - Joints:
 - Stability/Instability
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 - Muscles: Strength/Weakness
- **Energy Efficiency**
 - Stride length/Step cadence
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- **Dynamic/Static Foot**
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- **Adaptation**

Safety/Injury

Forces: Accelerations/Decelerations

- Loading forces
 - Stride length
 - Foot strike
 - Pressure
 - Impulse
- Joint movement forces
 - Torques/Moments
 - More motion/more force

• Safety/Injury

- Balance/Imbalance-Falls
- Resistance/Susceptibility
 - Forces: Accelerations/Decelerations
 - Joints:
 - Stability/Instability
 - Traction/Impingement
 - Muscles: Strength/Weakness

• Energy Efficiency

- Stride length/Step cadence
- Braking
- Gliding
- Bounce/Elasticity
- Resonance
- Muscle work

• Performance

- Dynamic/Static Foot
- Posture
- Adaptation

Precontact

Set-up For Loading

DW/HBW



HTW



Set-up

- Foot strike
- Knee position
- Foot position relative to COM

Initial Contact

Foot Strike

DW/HBW



HTW



Foot Strike

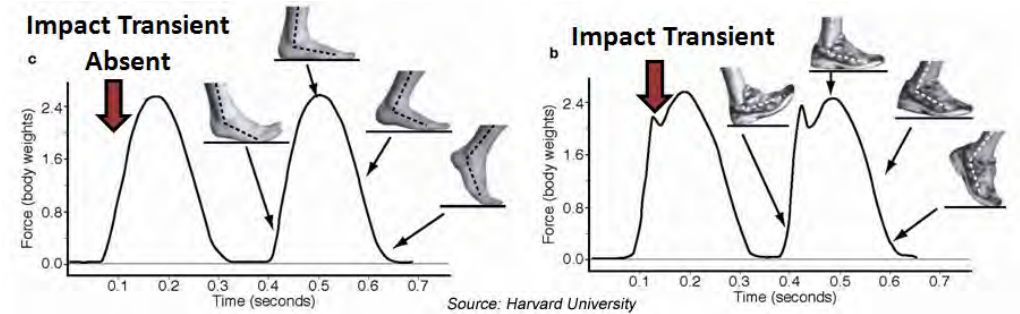
- Fore-foot strike (ball)
- Mid-foot strike
- Rear-foot strike (heel)

Initial Contact Loading Forces

DW/HBW



HTW



Safety/Injury

Joints: Stability/Instability

- **DW/HBW**

- Muscle co-contractions
 - Multiple muscle contractions at any moment
 - More isometric contractions
- Joint stability - creates dynamic stability
- Ligament/capsule strains – less
- Tendon traction injury - less
- Joint impingement - less

- **HTW**

- Agonist/antagonist
 - Single muscle contraction at any moment
 - More concentric contractions
 - More eccentric contractions
- Joint stability - relies more on static stability
- Ligament/capsule strains - more
- Tendon traction injury - more
- Joint impingement - more

- **Safety/Injury**

- Balance/Imbalance-Falls
- Resistance/Susceptibility
 - Forces: Accelerations/Decelerations
- Joints:
 - **Stability/Instability**
 - Traction/Impingement
 - Muscles: Strength/Weakness

- **Energy Efficiency**

- Stride length/Step cadence
- Braking
- Gliding
- Bounce/Elasticity
- Resonance
- Muscle work

- **Performance**

- **Dynamic/Static Foot**

- **Posture**

- **Adaptation**

Safety/Injury

Joints: Traction/Impingement

- **TRACTION**

- Hip – hamstring avulsion
- Hip – gluteus medius tendinitis
- Knee – patellar tendinitis
- Knee – quadriceps tendinitis
- Knee – Osgood – Schlatter disease
- Ankle – Achilles injury
- Heel – Sever disease

- **IMPINGEMENT**

- Hip – FAI/Labral tear
- Knee – posterior sprain
- Ankle – anterior ankle impingement
- Midfoot – dorsal midfoot arthritis
- Hallux – orsal arthritis

- **Safety/Injury**

- Balance/Imbalance-Falls
- Resistance/Susceptibility
 - Forces: Accelerations/Decelerations
- Joints:
 - Stability/Instability
 - **Traction/Impingement**
- Muscles: Strength/Weakness

- **Energy Efficiency**

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- **Performance**

- **Dynamic/Static Foot**

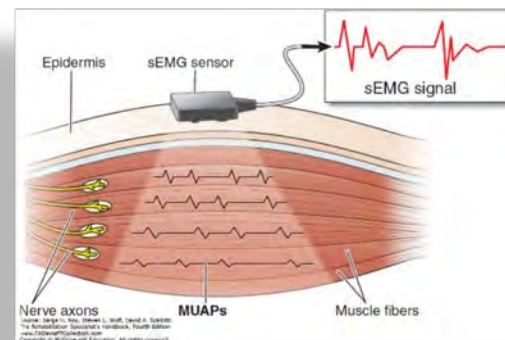
- **Posture**

- **Adaptation**

Safety/Injury

Muscles: Strength/Weakness

- **ACTIVE WALKING (DW/HBW)**
 - Muscle co-contractions
 - Muscles contracting each step – more
 - Increased lower extremity strength over time
 - Obesity less problematic
- **LAZY WALKING (HTW)**
 - Agonist/antagonist
 - Muscles contracting each step – less
 - Decreased lower extremity strength over time
 - Muscle weakness causes arthritis



- **Safety/Injury**
 - Balance/Imbalance-Falls
 - **Resistance/Susceptibility**
 - Forces: Accelerations/Decelerations
 - Joints:
 - Stability/Instability
 - Traction/Impingement
 - **Muscles: Strength/Weakness**
- **Energy Efficiency**
 - Stride length/Step cadence
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- **Dynamic/Static Foot**
- **Posture**
- **Adaptation**

Safety/Injury

Forces/Joint Stability/Muscle Strength

(DW/HBW)



(HTW)



Stride Length Dependent

- DW/HBW

- Accelerations/decelerations – lower
- Joint motion forces – lower
- Joint dynamic stability – higher
- Joint tractions – less
- Joint impingement - less
- Muscle strengthening – higher with each step

- HTW

- Accelerations/decelerations – higher
- Joint motion forces – higher
- Joint dynamic stability – lower
- Joint tractions – more
- Joint impingement - more
- Muscle strengthening – lower with each step

MUSCULOSKELETAL (MSK) DISEASE

MSK diseases occur because people are too weak for their body weight and activity level due to the maladaptive heel-toe walking gait created by shoes and aggravated by the modern cushioned shoe.