

Dr. Mark T. Dean

**Optometric Physician
Fellow COVD**

843-293-1555 or 843-902-6872

grandstrandvision@sccoast.net



It is good to rub
and polish our
brain against that of
others.

Montaigne

**I have no financial
interest in anything I am
talking about today.**

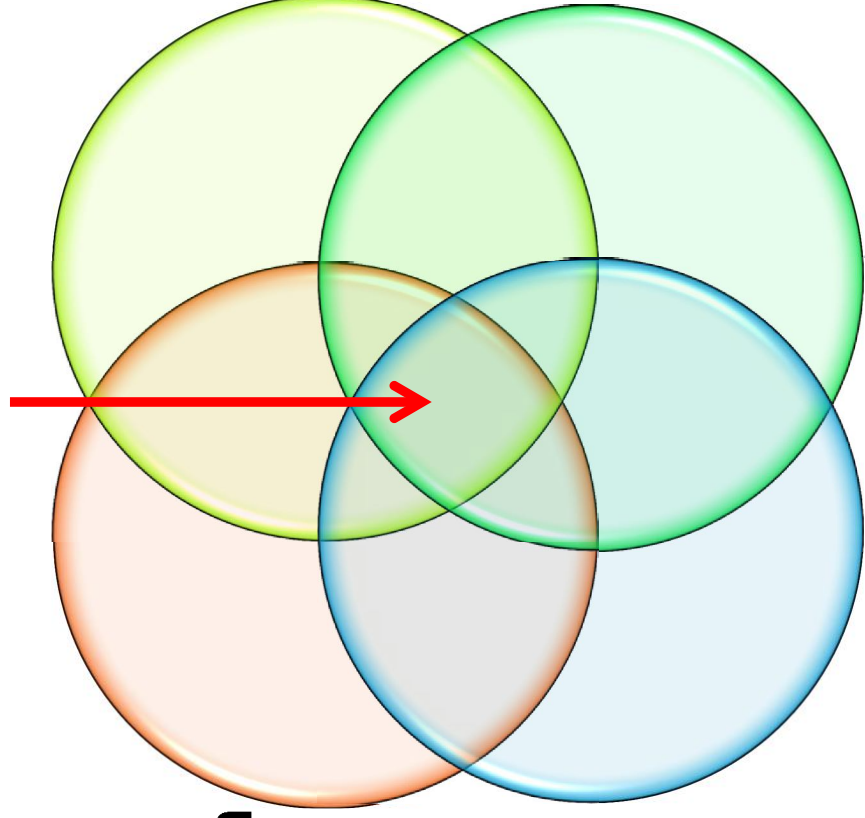


Vision is the deriving of meaning and direction of action as triggered by light.

"Vision is an active process of exploration and guidance relying on learned agreements between the senses and movement in past worlds."

David Cook, OD, FCOVD

Vision



Spatial localization

“Where is it?”

Identification

“What is it?”

Anti Gravity

“Where am I?”

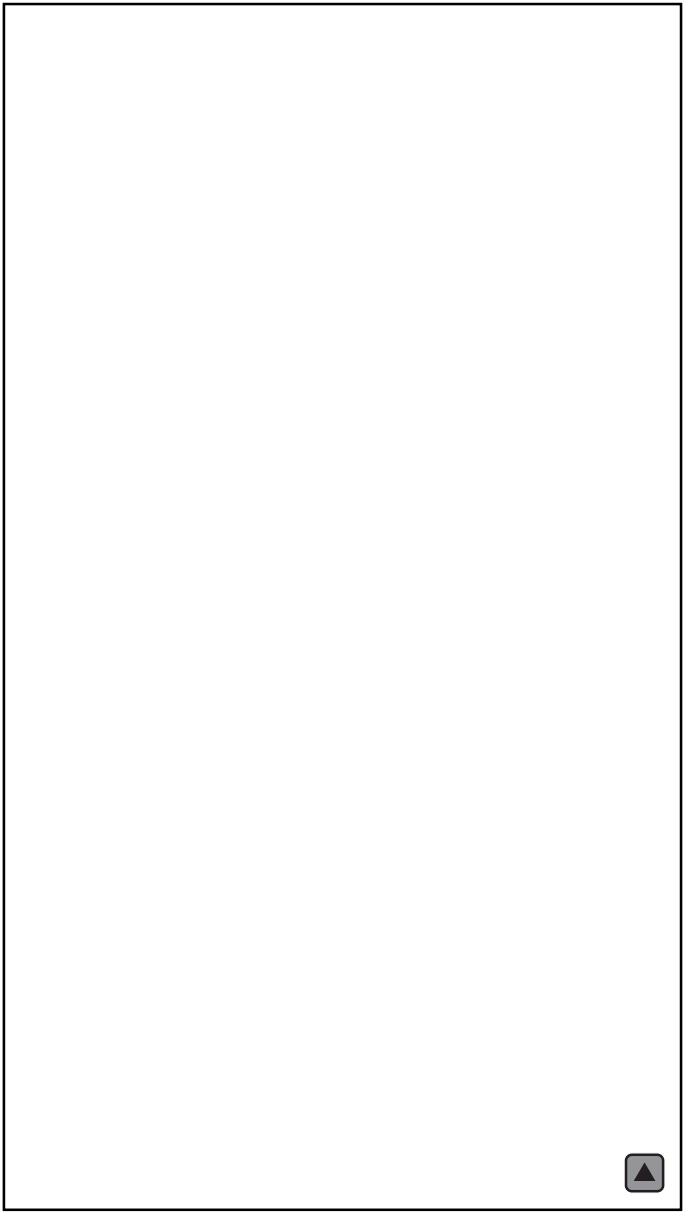
Speech / Auditory

“Communication”

DISCUSSION
ON WALKING







“I like to go to Disneyland to see how people use their visual system. How they interact with the visual experiences tells me so much about their visual processing.”



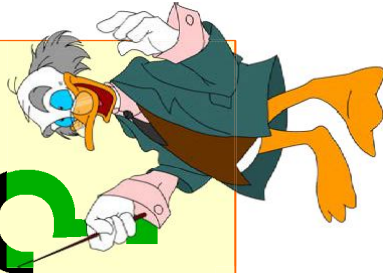


I was so accustomed to being “spoon fed” information that I couldn’t make the connections.

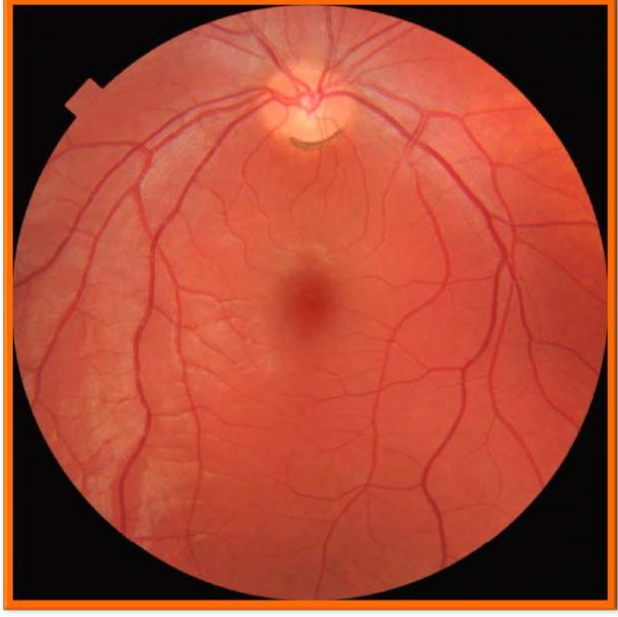
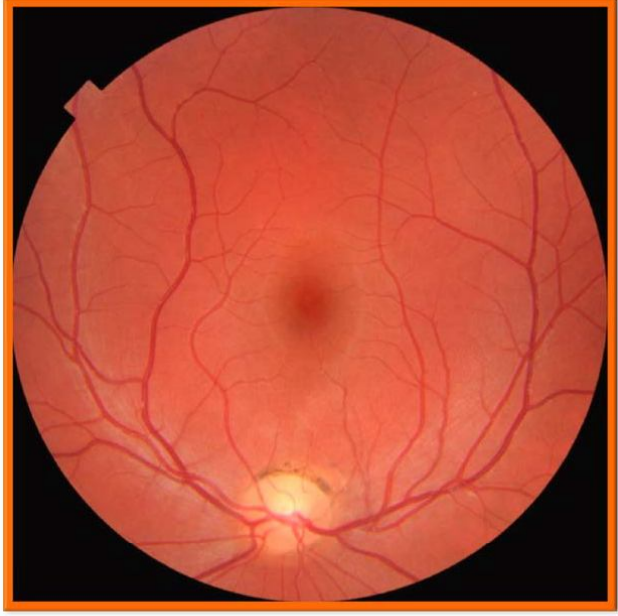
What is a

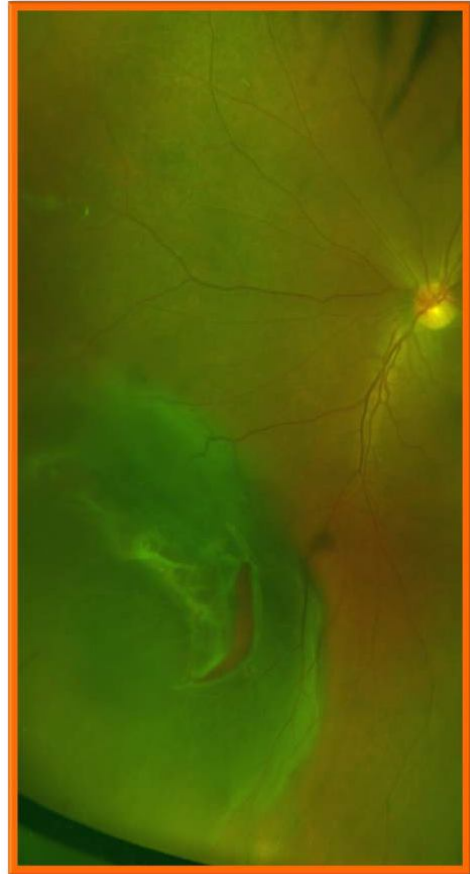
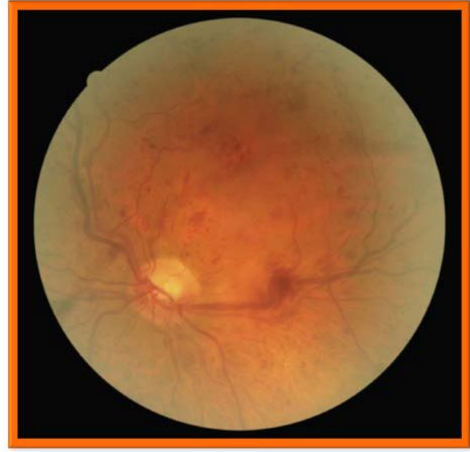
Normal

Walking Gait?



Normal Eyes





NORMAL GAIT

ARM SWINGS

STANCE PHASE

SWING PHASE

DEGREE OF TOE OUT



Normal Gait

Series of rhythmical, alternating movements of the trunk & limbs which results in the forward progression of the center of gravity.



Series of 'controlled falls'

AIRMS
SWIMS



Arm Swing Phase

Arm swings in motion with the opposing leg.

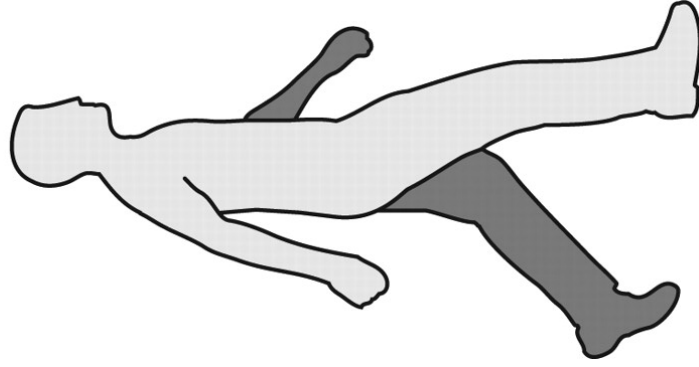
An active process with movement at the shoulder with arms close to the body.

Reduces angular momentum and balances rotational motion.

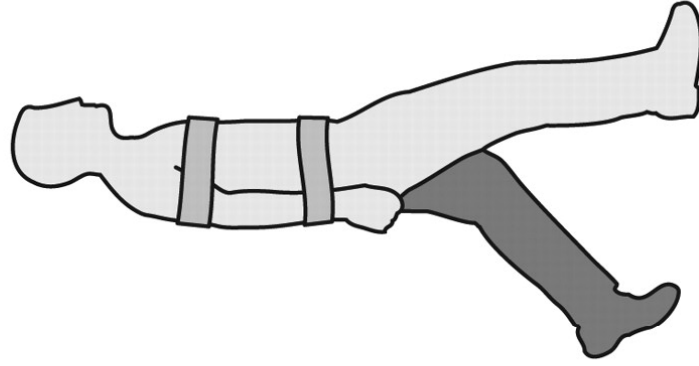
Stride is more efficient by counterbalancing torso and hips from twisting and bobbing.

Arm Swing Phase

Normal

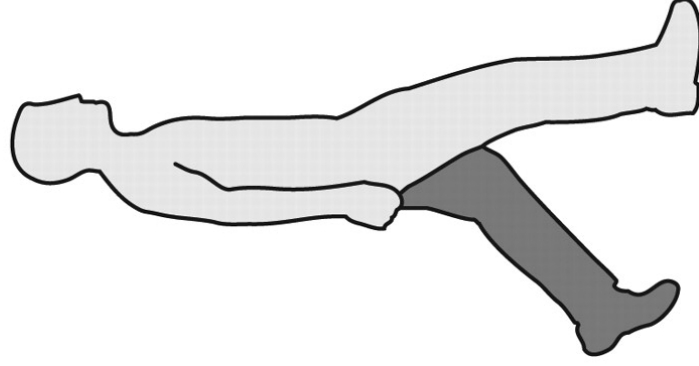


Bound



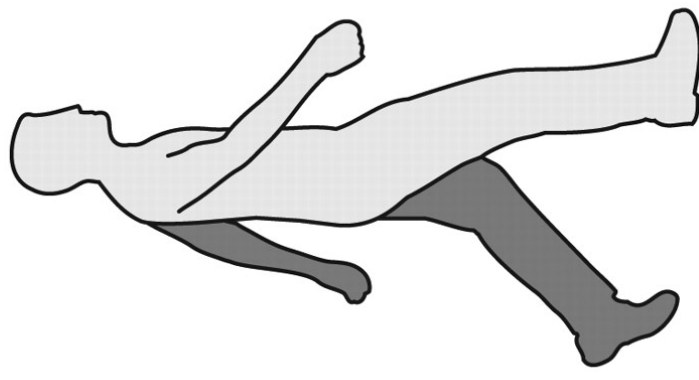
7% More

Held



12% More

Anti-Normal



26% More

STANCS
PHASE



Stance Phase

It begins at the instant that one extremity contacts the ground & continuous only as long as some portion of either foot or both feet is in contact with the ground.

It is approximately 60% of normal gait duration.

Stance Phase

Double Support: Heel strike and toe off occur at the same time.

Single Support or Mid Stance: Always corresponds to the contralateral swing period.

Stance Phase

Double Support

Heel Strike: The initial foot contact with the walking surface.

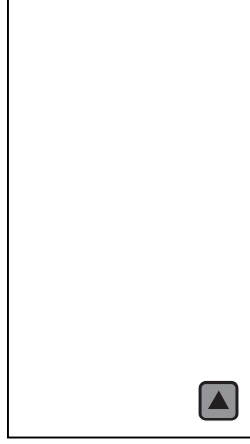


Stance Phase

Single Support or Mid Stance

Pronation: The foot rolls inwards.

Supination: The foot rolls outwards.



Stance Phase

Double Support

Toe-Off : The foot pivots at the ankle from dorsiflexion to plantarflexion.

This produces a toe-off propulsion which moves the center of gravity forward.



Stance Phase

Lateral Displacement

Due to weight shift from one foot to the other.

Lateral limit occurs at single stance



Average – 50 mm or 2 in.



Stance Phase

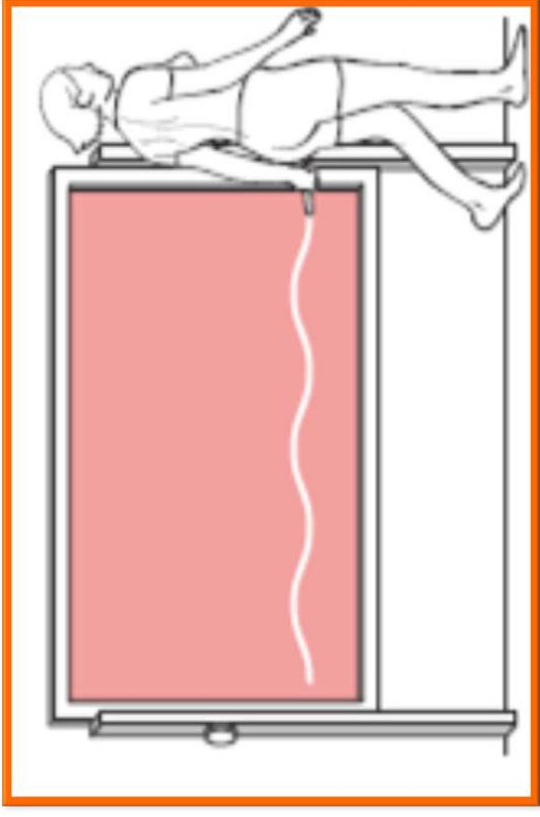
Vertical Displacement

Up and down movement

Highest - mid stance

Lowest - double support

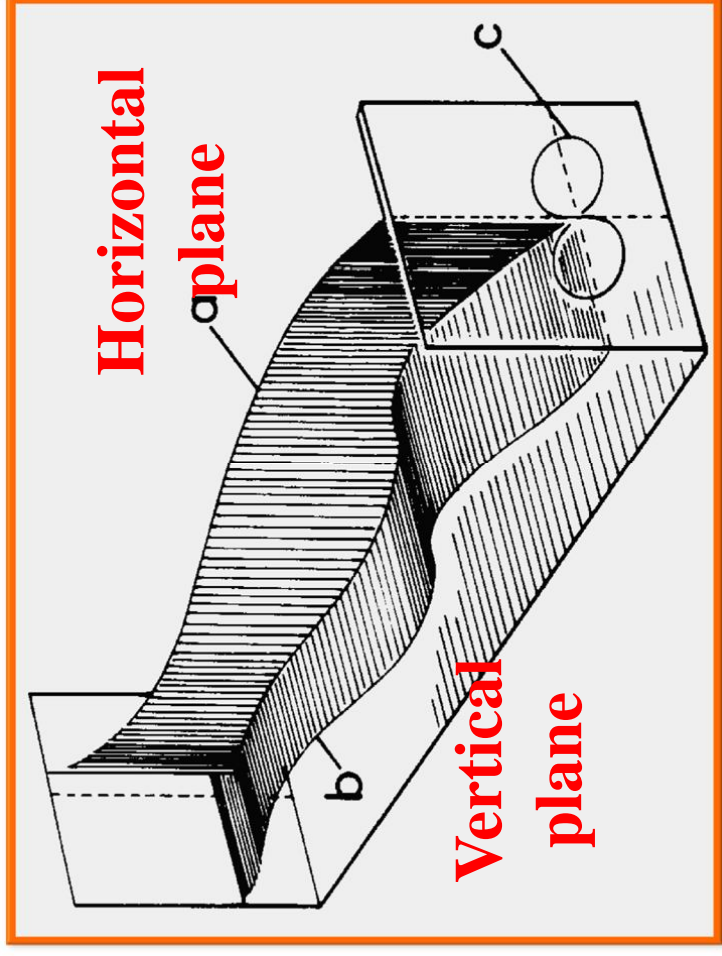
Average - 50 mm or 2 in.



Stance Phase

Vertical and Lateral Displacement

This graph shows a smooth sinusoidal movement vertically and horizontally.



SWING
SHASE



Swing Phase

Begins as soon as the toe leaves the ground & ceases at heel strike or ground contact of the same extremity.

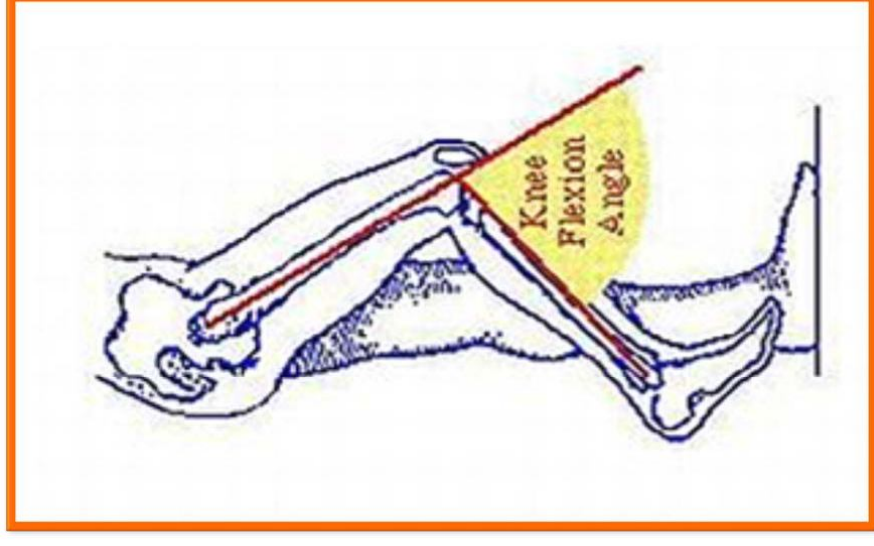
It makes up 40% of normal gait cycle.

Swing Phase

Knee Flexion: Approx. 20°

This shortens the leg in the middle of stance phase.

Dorsiflexion to lift the foot



Swing Phase

Pelvic Rotation: There is a forward rotation of the approximately 8° . This enables a slightly longer step length.

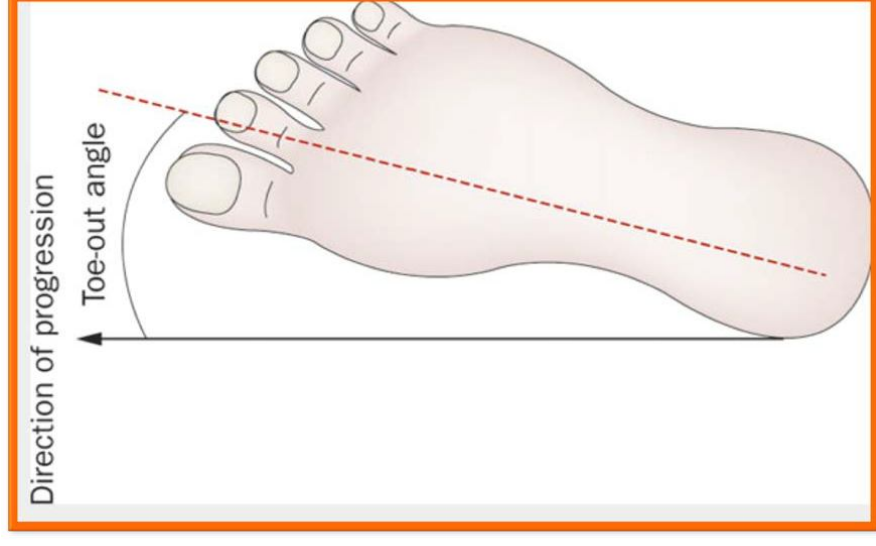


DEGREE OF
TODD



Degree of Toe – Out (DTO)

It represents the angle of foot formed by each foot's line of progression and a line intersecting the center of the heel and the second toe.

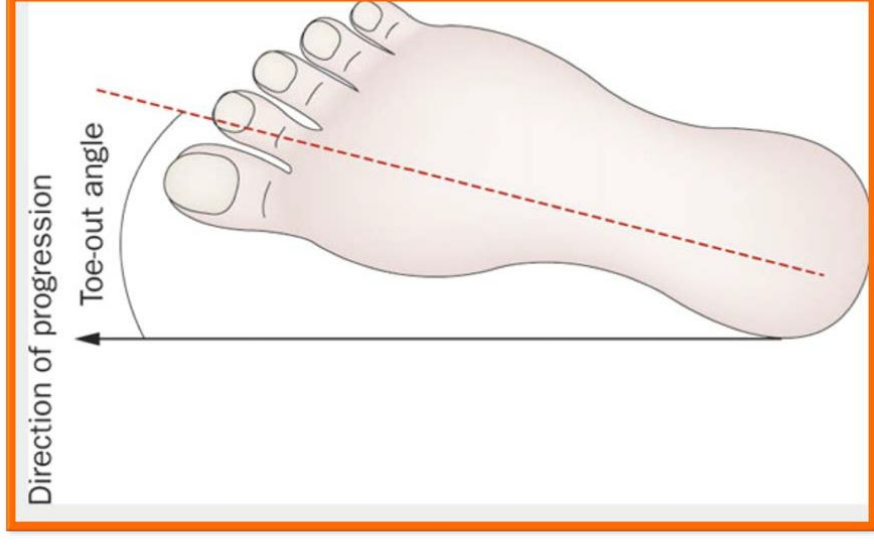


Degree of Toe – Out (DTO)

Infants - about 15°

Adults - about 7°

The DTO decreases as the speed of walking increases.



STEP WIDTH/LENGTH

STRIDE LENGTH

SPEED OF GAIT

CADENCE

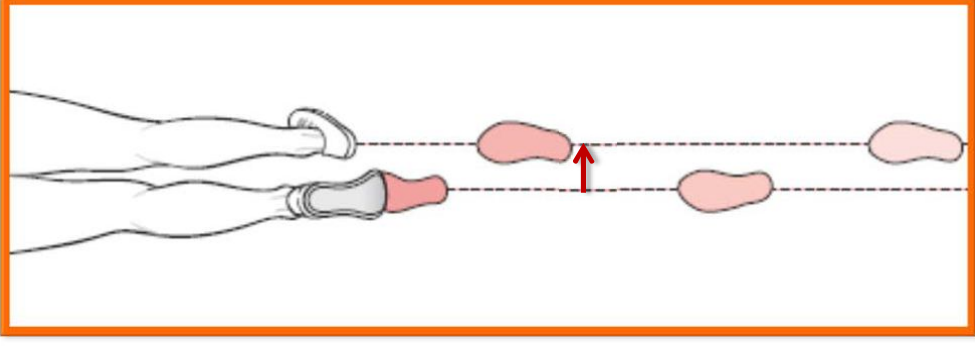
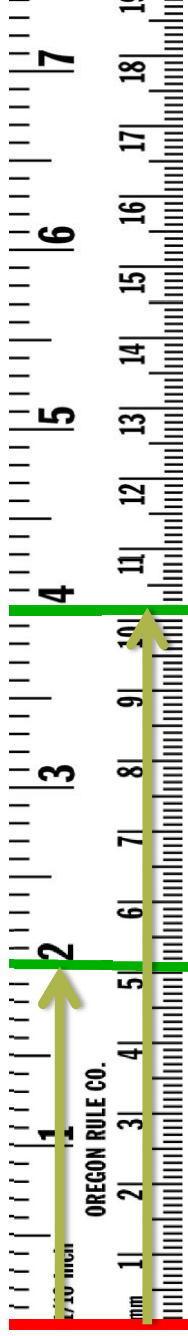


Step Width

Width of the walking base.

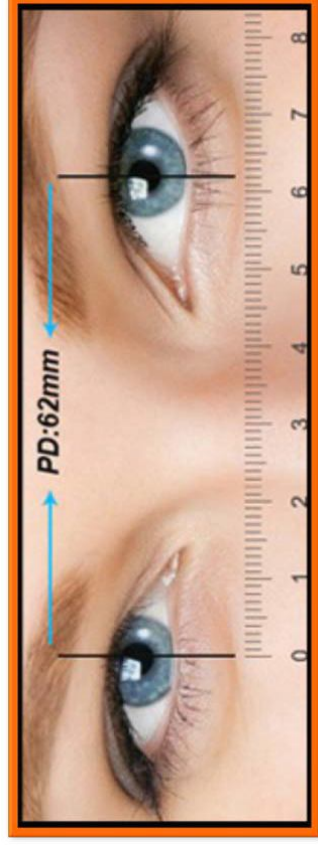
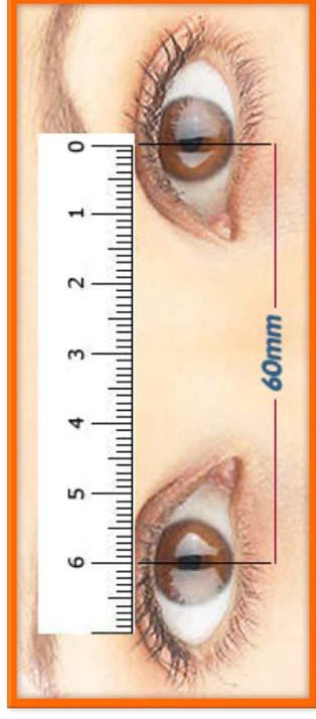
The linear distance between the midpoint of the heel of one foot and the same point on the other.

50 – 100 mm or 2 – 4 in.



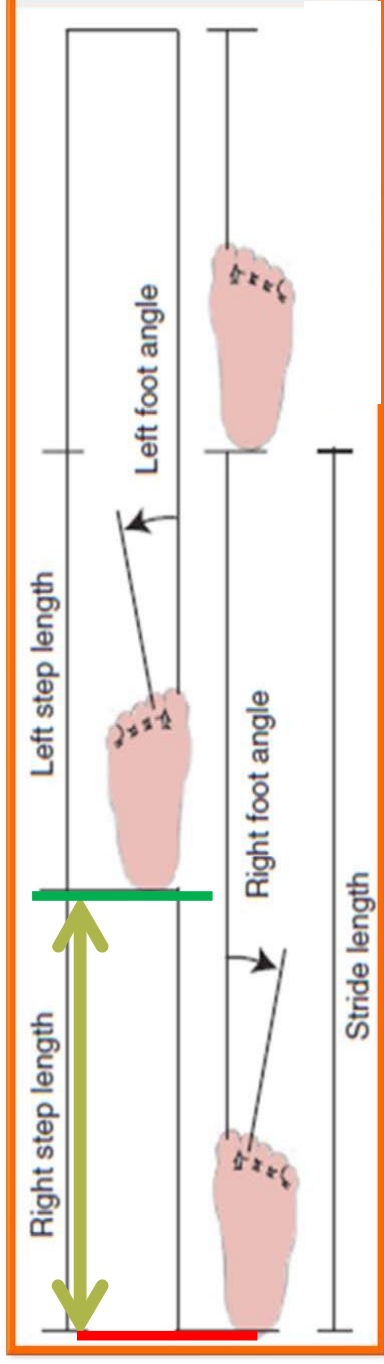
Step Width

What else has about the same measurements?



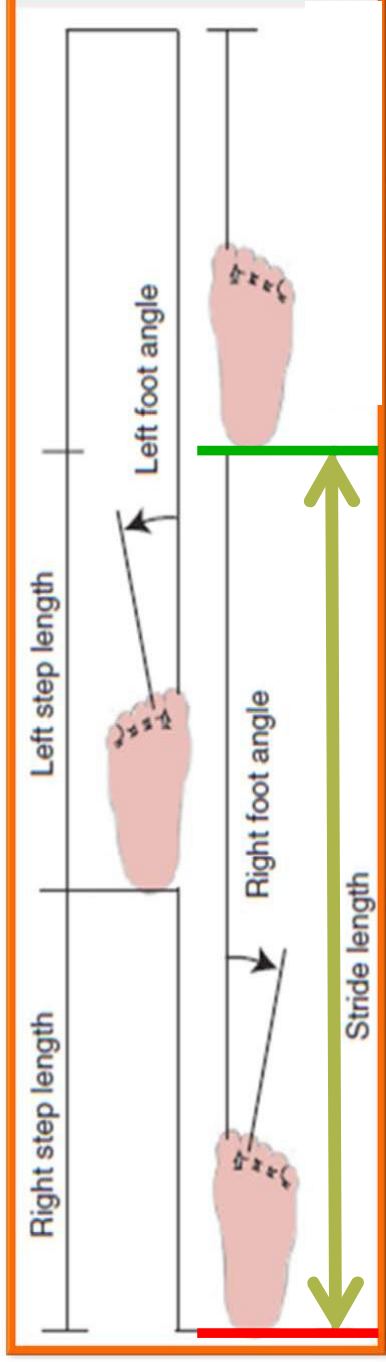
Step Length

The linear distance from the heel strike of one foot to the heel strike of opposite foot.



Stride Length

The distance from the heel strike of one foot to the next heel strike of the same foot.

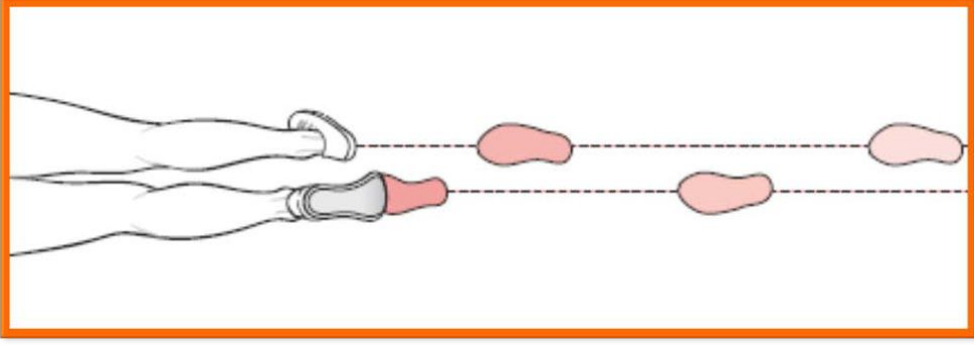


Cadence

$$\text{Cadence} = \frac{\text{Number of steps}}{\text{Time in sec.}}$$

This decreases significantly between the 1 – 2 years of age

By age 4 the interrelationship between temporal/distance measures is fixed.



Normal Gait

The amount of time taken to accomplish one stride with all the elements we just talked about is:

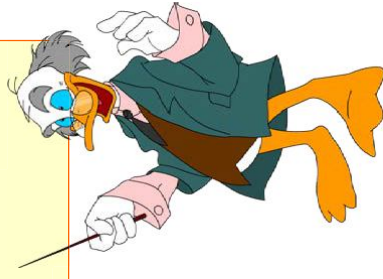
About 1 sec in normal adults

Speed of gait

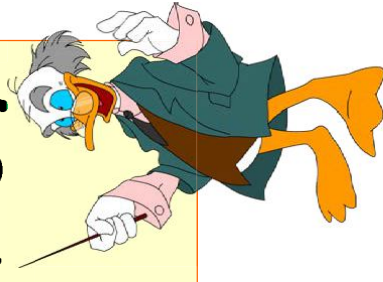
Depends on the environment

- Free: A person's normal walking speed.
- Slower: Slower than their normal speed.
Indoors and shorter distances.
- Faster: Faster than their normal speed.
Outdoors and longer distances.

“Abnormal” Walking Gaits



Any change in the symmetry
of the rhythmical, alternating
movements of the trunk &
limbs reflected in the gait
period durations is an index of
gait pathology



ANTALGIC GAIT

HIP HIKE GAIT

FOOT SLAP/TOE DRAG GAIT

TRENDLENBERG GAIT

ATAXIC GAIT

TOE WALKING/IDIOPATHIC GAIT

DIAPER GAIT



Abnormal Walking Gait

Pain

Muscular weakness/paralysis

Neurological involvement (UMN/L/ LMNL)

Joint muscle range-of-motion (ROM) limitation

Leg length discrepancy

Vision

Antalgic Gait

Avoid Pain Gait

A shortened, often abducted, stance phase on the involved side results in a rapid and shortened step length of the uninvolved side

Common Causes:

Injuries; JRA; Osteoarthritis; Foot wear
sleep



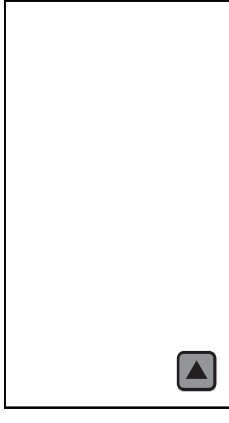
Hip Hike Gait

Steppage: Vaulting or Circumduction

Lifting the leg higher than normal when walking.

Common causes:

Swing leg longer than the stance leg;
Inadequate dorsiflexion



Foot Slap/Toe Drag Gait

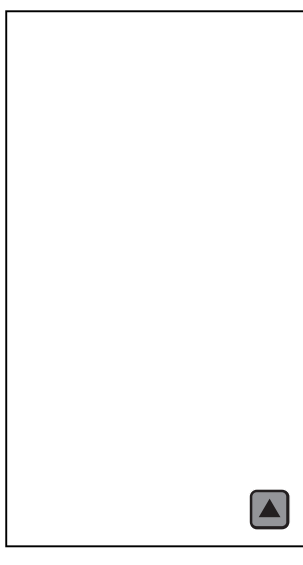
Foot slaps or toe drags when walking

Swing: In mid swing the toe may drag on the floor unless the hip is raised up.

Stance: On heel contact foot slaps the ground

Common causes:

Inadequate dorsiflexion control



Trendelenberg Gait

Waddling gait (gluteus medius)

The body leans over the affected leg during stance and the pelvis of the opposite leg drops when begin swing phase.

Common causes:

Weak Abductor; Injury; Abnormal hip joint;

Binocular Dysfunction(?)



Trendelenberg Gait

**Is it possible that a person
may be strabismic and
develops a waddling pattern
as a result of their
deficiency?**

Ataxic Gait

Spastic Gait

Wider Base (Feet apart more than 10cm or 4")

Arms out and away from body.

Jerky movements; poor balance; staggers.



To keep her balance the child with ataxia walks bent forward with feet wide apart. She takes irregular steps, like a sailor on a rough sea or someone who is drunk.

Ataxic Gait

Common causes:

Deformities

Instabilities (Cerebellar ataxia)

Proprioception deficits

Vision proprioception(?)



To keep her balance the child with ataxia walks bent forward with feet wide apart. She takes irregular steps, like a sailor on a rough sea or someone who is drunk.

Is it possible that the ataxic gait develops, in part, because of a vision problem creating instability in their view of the world?

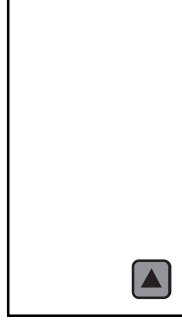
Toe Walking Gait

This is a toe-to-toe gait pattern

A person walks on their toes without having a heel strike throughout all phases of gait.

Common causes:

Neuromuscular and Musculoskeletal Disorders; Behavioral Disorders



Idiopathic Toe Walking Gait

An intermittent toe-to-toe gait pattern

A person walks mostly on their toes and sometimes having a heel strike.

Common causes:

Unknown; No signs of neurological, orthopedic or psychological conditions;

Idiosyncratic Habit

Idiopathic Toe Walking Gait

Developmental History

Onset in children 18 to 36 months of age

Affects 5% to 12% of the children

Developmental delays

Both receptive and expressive language
“...between 24% to 54% have an average delay of about 14 months.”

Idiopathic Toe Walking Gait

Developmental Coordination Disorder

Gross motor and bilateral integration issues

Fine motor issues

Visio-motor (constricted performance fields)

Binocular Dysfunction

Vision Proprioception

**Is it possible that a toe
walking gait develops, in
part, because of a vision
problem creating instability
in their view of the world?**

Diaper Gait



**Does wearing diapers
interfere with an infant's
walking gait development
and potentially interfere
with binocular vision
development?**

Diaper Gait

Developmental Science

Developmental Science 15:6 (2012), pp 783–790

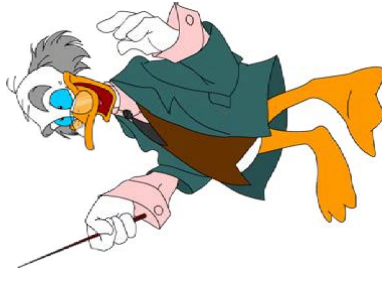
DOI: 10.1111/j.1467-7687.2012.01169.x

PAPER

Go naked: diapers affect infant walking

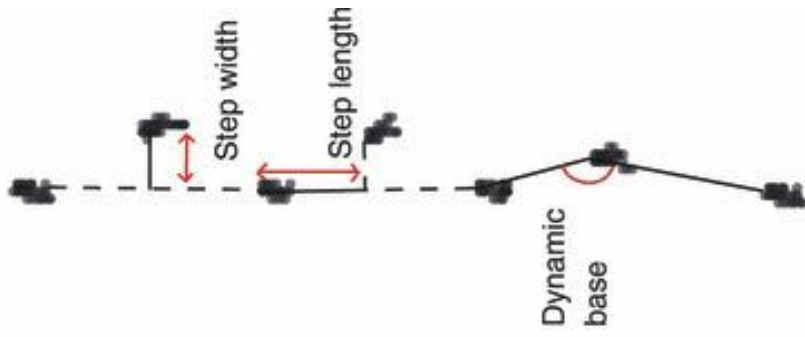
Whitney G. Cole, Jesse M. Lingeman and Karen E. Adolph

Department of Psychology, New York University, USA



Diaper Gait

(B) Gait Parameters



Naked



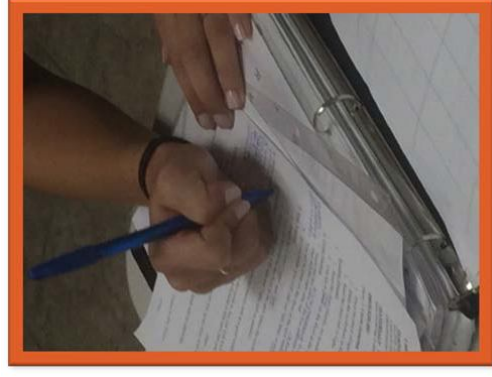
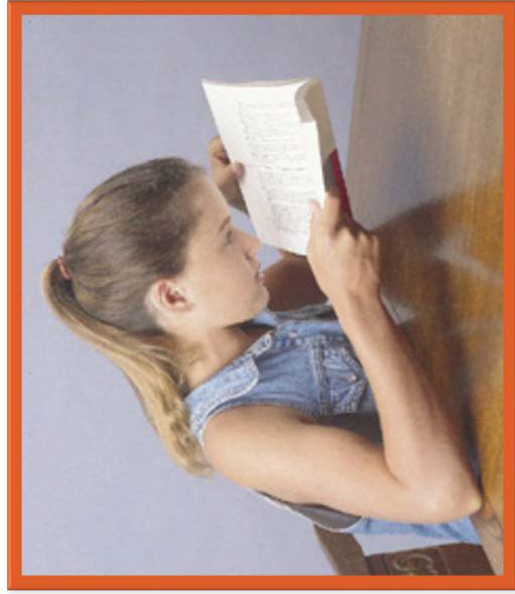
Cloth



Disposable



Does this suggest that one of the treatment techniques for toddlers is to have periods of time without diapers?



We observe that these are symptoms of a vision problem.

Why not

“Abnormal”

Walking Gait?

*When vision works well,
vision leads and guides in
all one does. When not
working well, it interferes.*





That's all folks!