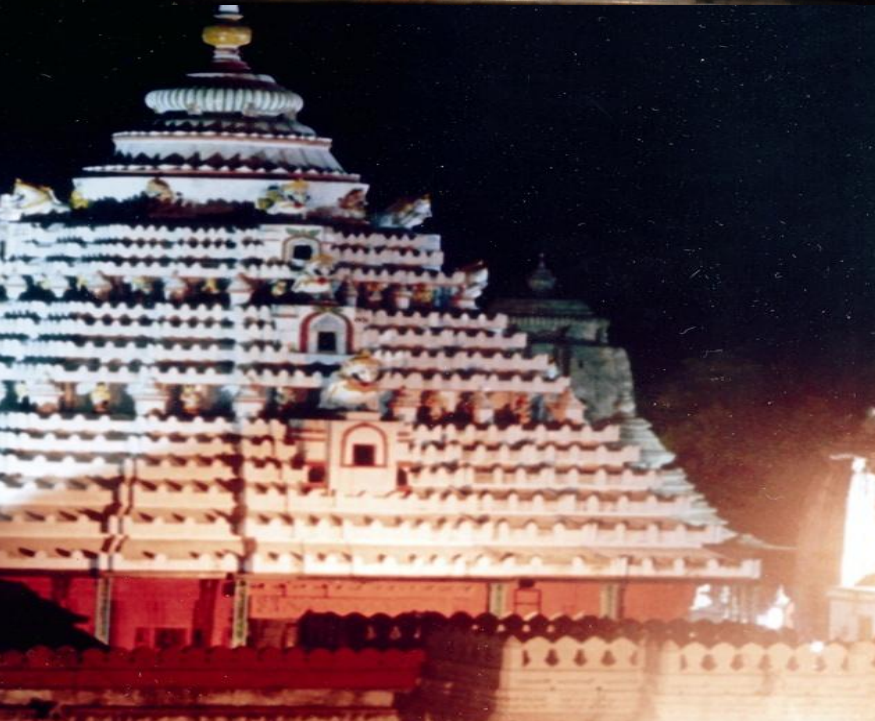


THE GAIT CYCLE AND GAIT EXAMINATION

DR SAKTI PRASAD DAS,
MS(ORTHO.), DNB(PMR)
DIRECTOR, SVNIRTAR, CUTTACK, ODISHA





SVNIRTAAR

प्रनवार्ग सेवा भवन
REHABILITATION SERVICES BUILDING



Gait

The systematic
study of of
human motion

Why gait analysis?

- Everyone has their own walking /running style

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- Assess and treat individuals with conditions affecting their ability to walk.

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- Assess and treat individuals with conditions affecting their ability to walk.
- Used in sports biomechanics to help athletes run more efficiently
- Identify posture-related or movement-related problems in people with injuries



Waddling gait





Gait cycle

- A **gait cycle** consists of “the activities that occur from the point of initial contact of one lower extremity to the point at which the same extremity contacts the ground again”
- During one gait cycle, each extremity passes through two phases, a single **stance** phase and a single **swing** phase.

THE GAIT CYCLE

- Bear weight
- Provide a means for locomotion
- Maintain equilibrium

THE GAIT CYCLE

- **STANCE PHASE 65%**
 - Contact Period - heel strike to forefoot loading
 - Midstance Period - forefoot loading to heel raise
 - Propulsive Period - heel raise to toe off
- **SWING PHASE 35%**
 - Acceleration
 - Deceleration

LOCOMOTION

Position of the Lower Extremity

Weight bearing / Fixed (Closed chain)

i.e. foot is on the ground

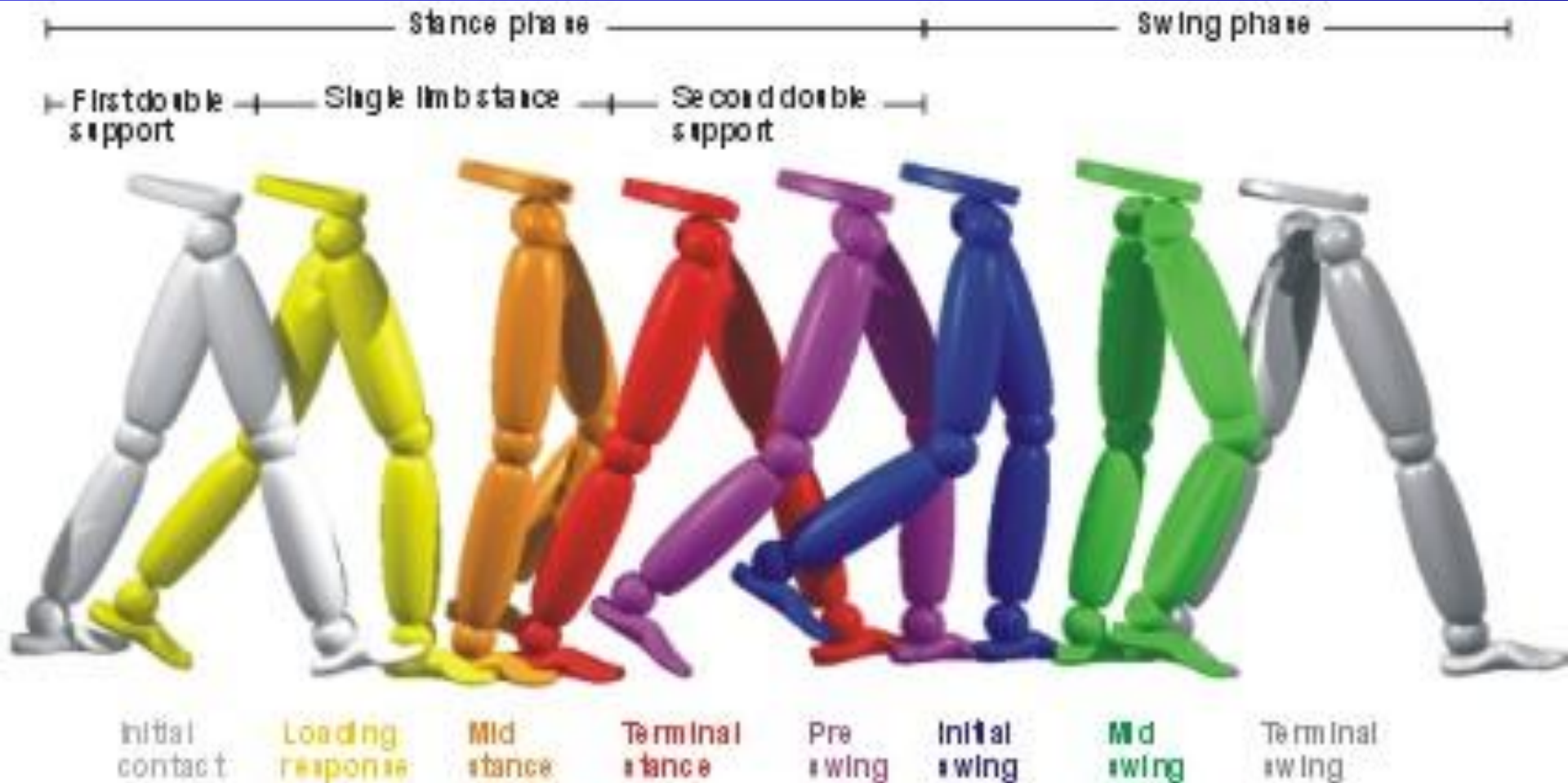
- body moves over the leg

Non weight bearing / Free (Open chain)

i.e. foot is off the ground

- leg moves under the body

A Single Gait Cycle or Stride



GAIT TERMINOLOGIES

■ Time and distances are two basic parameters of motion.

1. **Temporal (Time) variables**
2. **Distance (Spatial) variables**



TEMPORAL VARIABLES

1. Single limb support time
2. Double support time
3. Cadence
4. Speed



Distance Variables

1. Stride length
2. Step length
3. Degree of toe out



The Gait Cycle:

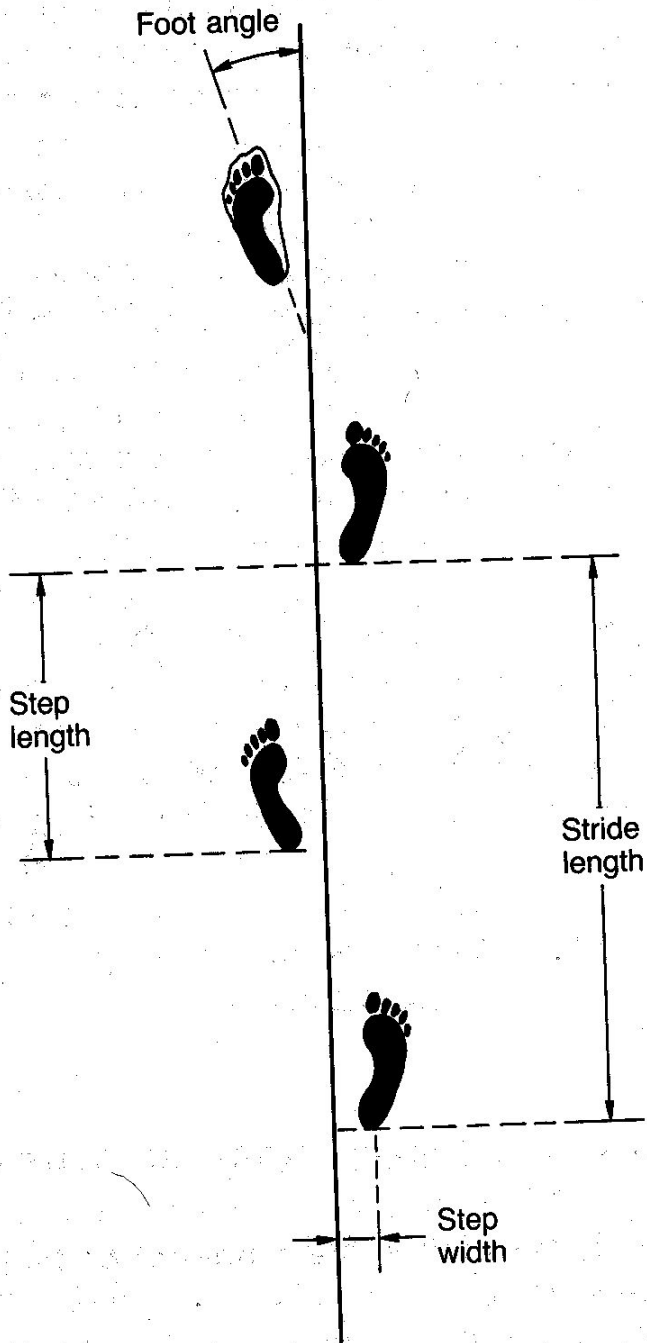


Fig. 15.1 Distance and temporal factors in gait

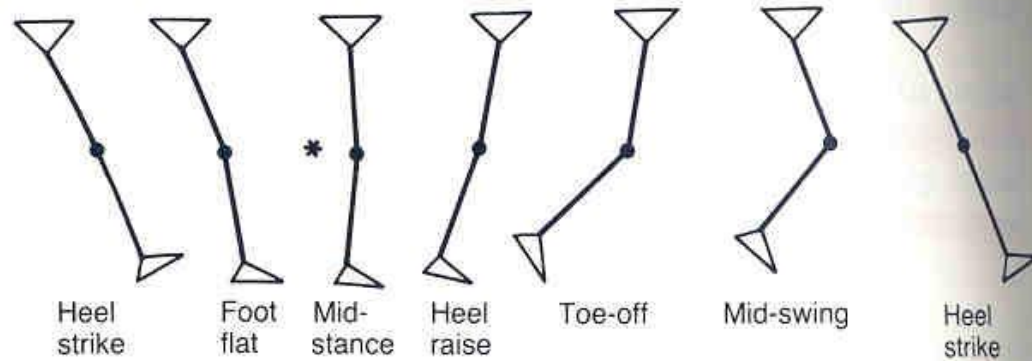
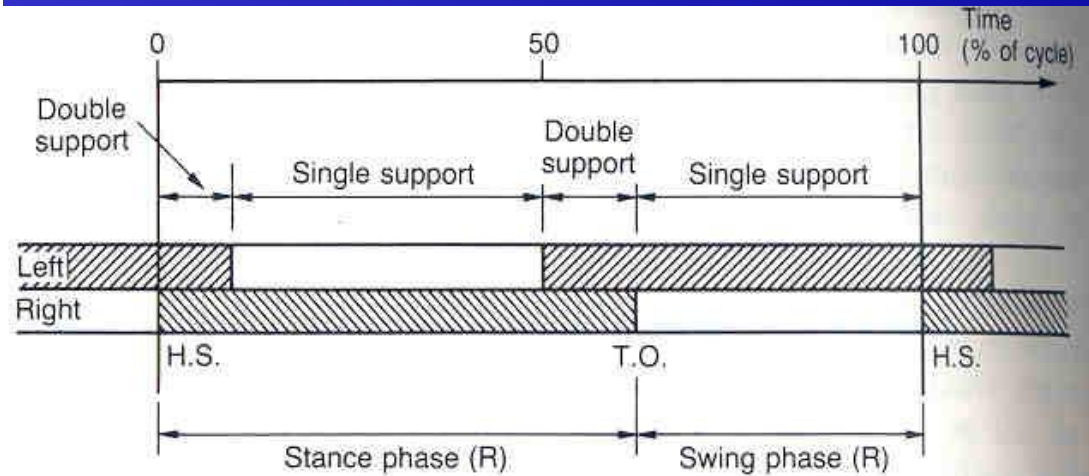


Fig. 15.2 Gait cycle



COMPARISON OF GAIT TERMINOLOGY

■ Traditional –

- 1) Heel strike
- 2) Foot flat
- 3) Mid-stance
- 4) Heel off
- 5) Toe off
- 6) Acceleration
- 7) Mid-swing
- 8) Deceleration

■ RLA –

- 1) Initial contact
- 2) Loading response
- 3) Mid-stance
- 4) Terminal stance
- 5) Pre-swing
- 6) Initial swing
- 7) Mid-swing
- 8) Terminal swing



VARIABLES

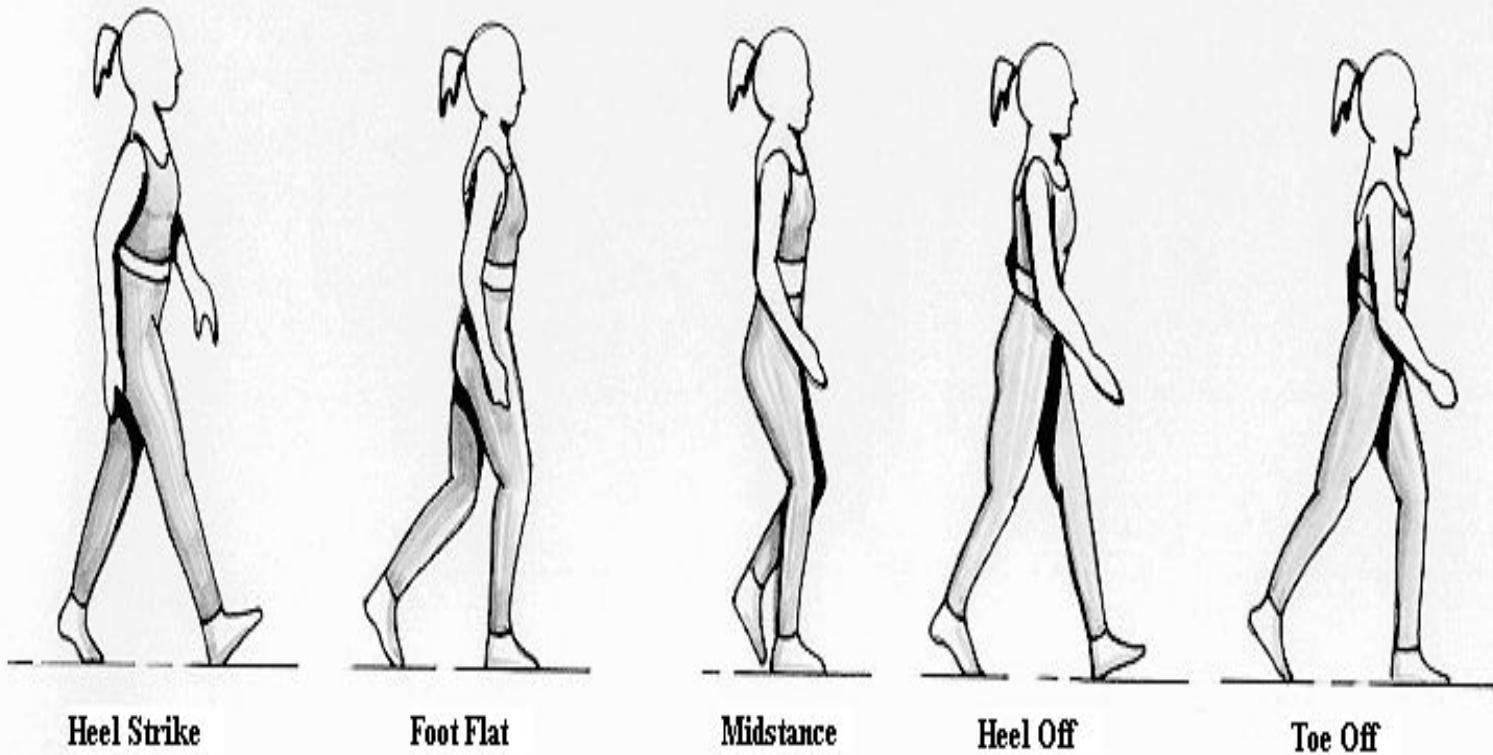
■ Temporal variable –

- Stance time
- Single-limb & double-support time,
- Swing time,
- Stride and step time,
- Cadence and
- Speed

■ Distance variable –

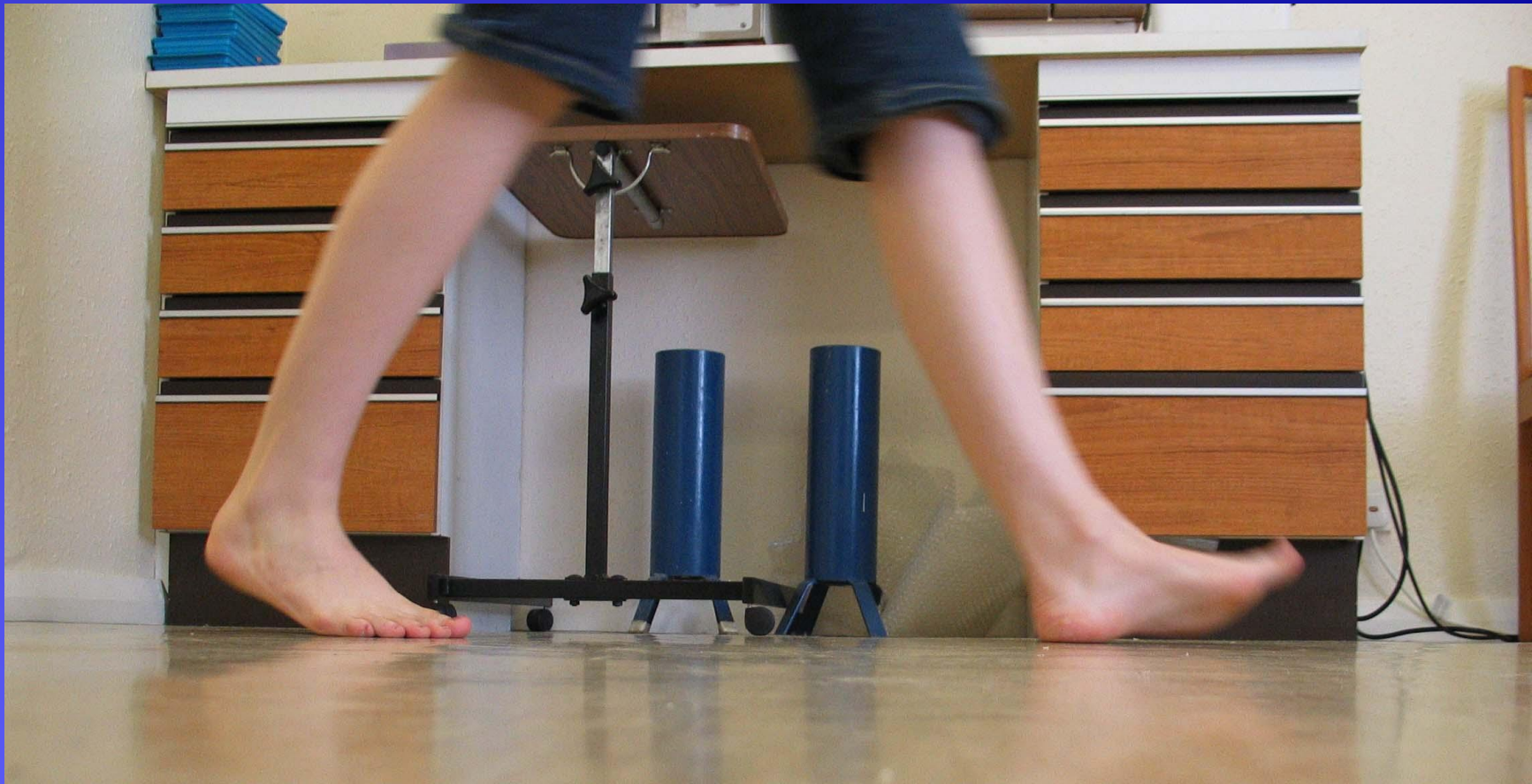
- Stride length,
- Step length and width
- Degree of toe-out

The Stance Phase



CONTACT PERIOD

- Heel strike to forefoot loading
- Foot pronates at subtalar joint
- Only time (stance phase) normal pronation occurs
- This absorbs shock & adapts foot to uneven surfaces
- Ground reaction forces peak
- Leg is internally rotating
- Ends with metatarsal heads contacting ground







MIDSTANCE PERIOD

- Forefoot loading to heel raise
- Foot stops pronating & starts supinating due to Tibialis posterior & Soleus contract
- And external rotation of the leg
- Other leg in swing phase – all weight on one foot
- Vertical ground reaction forces decrease – body is directly over foot
- Ends as heel leaves ground





PROPULSIVE PERIOD

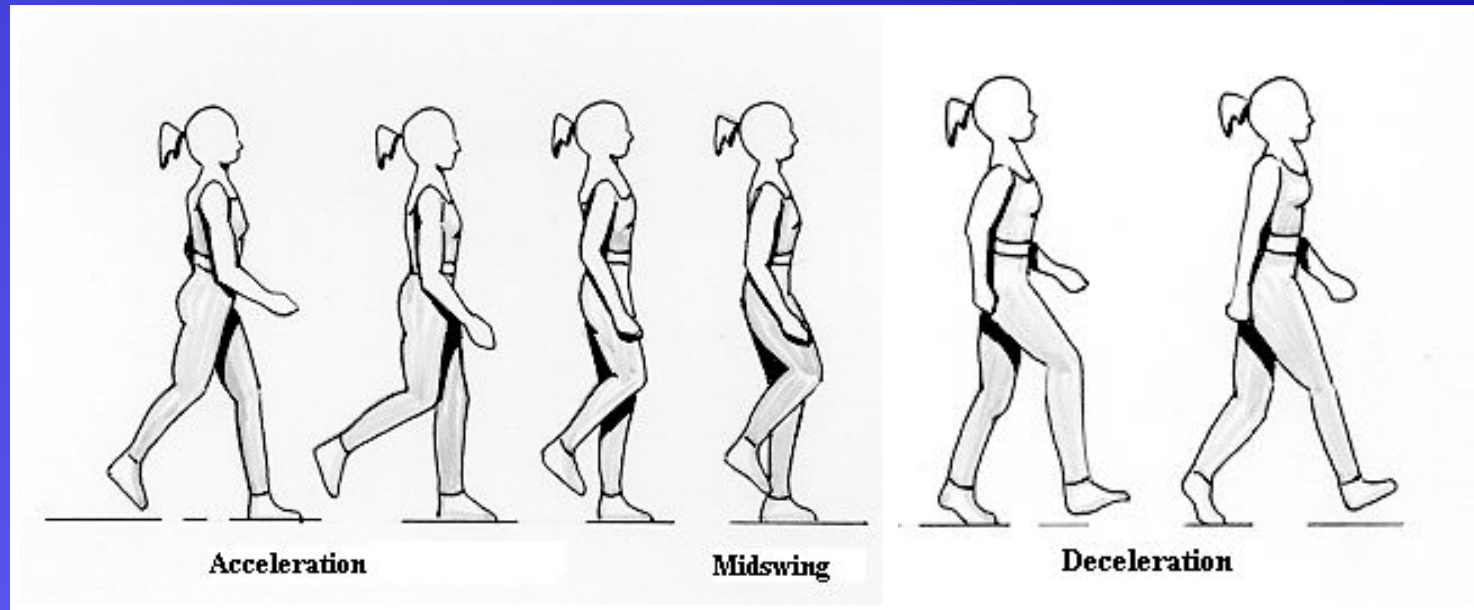
- Heel raise to toe off
- Subtalar joint supination continues until just after toe off
- Leg continues to externally rotate
- Vertical ground reaction forces peak – forefoot only bearing weight on this side
- Forces move from lateral to medial passing through the hallux
- First MPJ must function correctly for maximum efficiency
- Toes are loaded to stabilise MPJ's







The Swing Phase



SWING PHASE

- **Foot accelerates to “catch up” with body**
- **Leg internally rotates (from external position)**
- **Foot pronates to aid ground clearance**
- **Foot decelerates and slightly supinates in preparation for heel strike**

GAIT EXAMINATION

- **Take a history**
- **Couch examination**
- **Static examination**
- **Allow patient time to relax**
- **Reasonable length walkway - gait pattern**

“NORMAL” STANDING POSITION

- Feet slightly abducted & shoulder width apart**
- Knees pointing forwards & extended**
- Heels are vertical**
- Ankles are approximately 90° leg**
- All MPJ's & toes are in contact with the ground**

COUCH EXAMINATION

- **Observe deformities & lesions**
- **Check ROM's**
- **Check muscle tightness/strength**
- **Neurological & vascular assessment**

STATIC EXAMINATION

- **Feet non-weight bearing (hanging) with weight bearing**
- **Standing from front**
 - **Shoulders, hips, knees, feet**
- **From behind**
 - **Shoulders, hips, calcaneus**

OBSERVE GENERAL POINTS

- Is the gait fast or slow?
- Is it smooth?
- Does the patient appear relaxed & comfortable or pained?
- Is it noisy?

FEET 1

- **Heel strike – towards lateral side?**
- **Is forefoot loading lateral to medial?**
- **Is normal pronation occurring?**
- **Any medial bulging?**
- **Arch normal, high, low or non-existent?**
- **Are the feet abducted, adducted or straight?**

FEET 2

- **Is the 1st MPJ functioning properly?**
- **Are the toes bearing weight?**
- **When is the heel lifting?**
- **Is toe off through the hallux?**
- **Does the swing phase appear normal?**
- **Are the feet too close or is the base of gait wide?**

LEGS

- **Are the knees pointing forwards?**
- **Is there genu valgum or varum?**
- **Is there tibial varum present?**
- **Do they appear internally or externally rotated?**
- **Knees from the side – are they fully extending?**

HIPS & BODY

- **Is there any excessive movements at the hips – rotations or listing?**
- **From the side – are there any excessive curves?**

HEAD & SHOULDERS

- Are the shoulders level?
- Do the arms swing equally?
- Does the head & neck appear normal?

PREVIOUS DESCRIPTION

- **WADDLING**
- **SCISSORING**
- **LIMPING**
- **JUMP**
- **TRENDELENBERG**
- **FESTINATING**
- **EQUINUS**

Gait Analysis

- **Observational gait analysis**
- **Video gait analysis-2D**
- **Gait Laboratory-3D- IGA**



OBSERVATIONAL GAIT ANALYSIS

- **SIMPLE**
- **COST EFFECTIVE**
- **SUBJECTIVE**
- **LACKS ACCURACY**
- **TRAINING AND EXPERIENCE**
- **TOOLS LIKE OGS, OGA, VGS, PRS-
NONE OF THESE COMPARED TO IGA(
GAIT AND POSTURE 2014)**

2- D GAIT ANALYSIS

- **A 2D Gait Analysis is carried out by taking a video recording of a person walking along a walkway (usually a number of times).**
- **Person's movements at hip, knee and ankle level, and their overall posture are assessed**
- **The video recording of the person walking is played back in slow-motion.**
- **2D Gait Analysis software may also be used to help analyse their gait and identify any problems.**

What is 3-D Gait analysis?

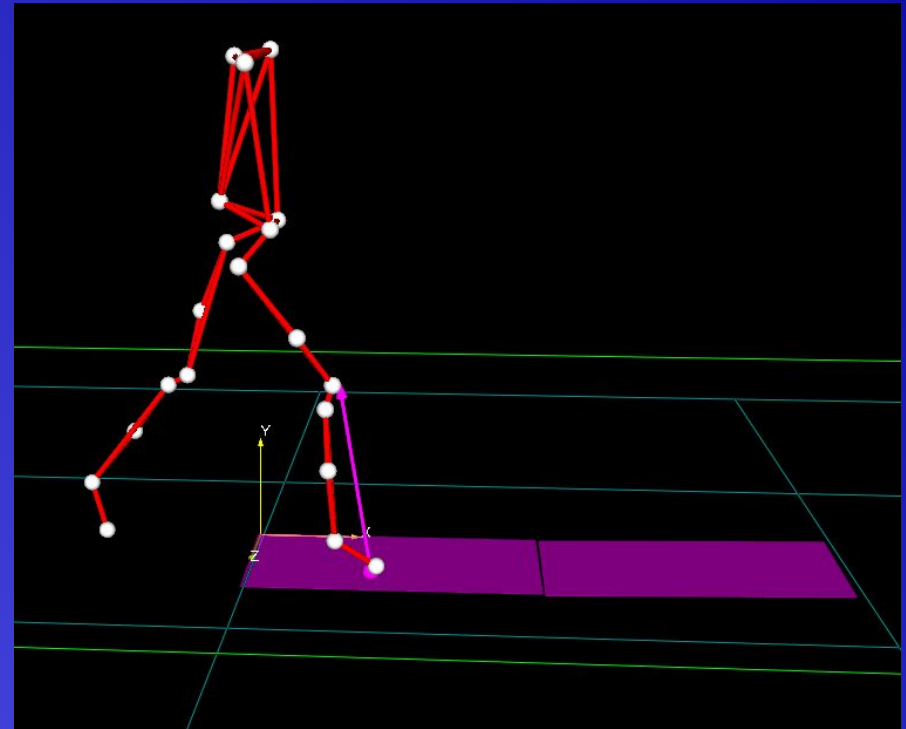
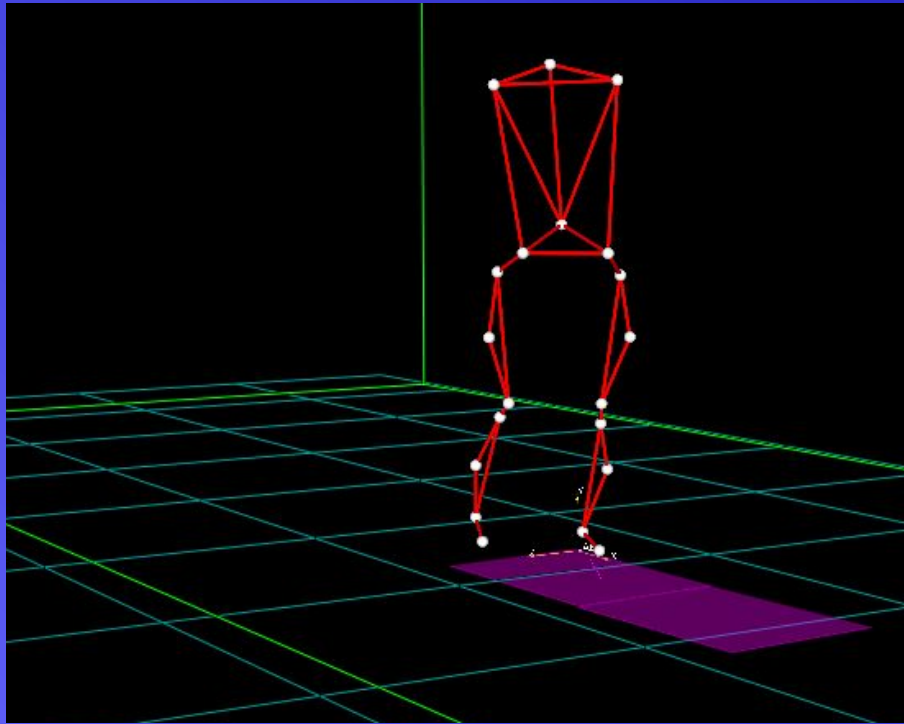
- **Objective data**
 - Walking velocity
 - Step length
 - Cadence
- **2-D videos in coronal and sagittal planes**
- **Joint movement in 3-D**
- **Measure forces going across each joint**
- **Dynamic EMG**
- **Ground reaction force vector**



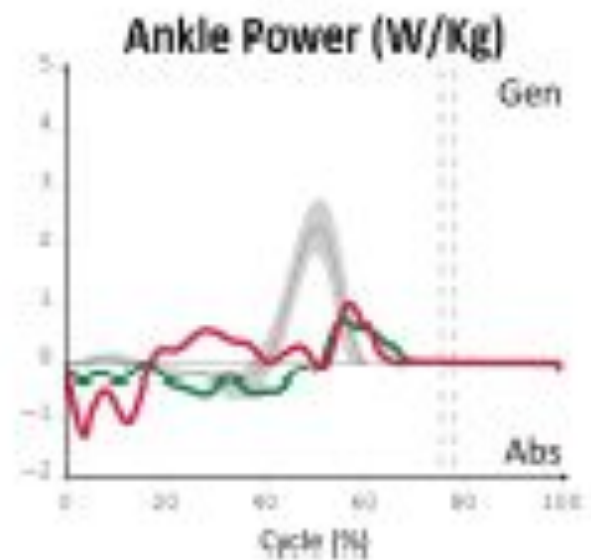
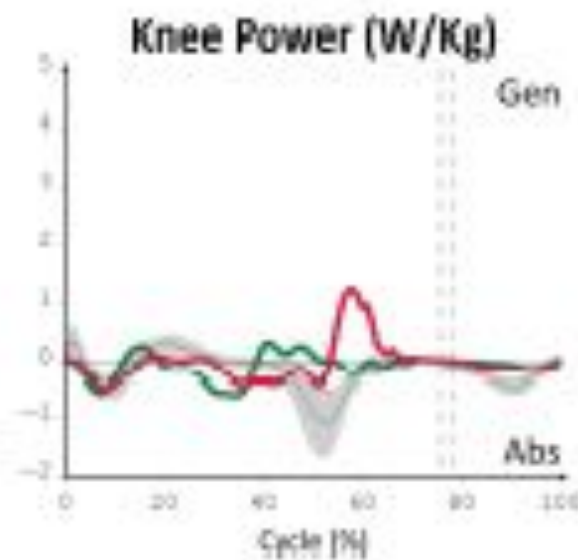
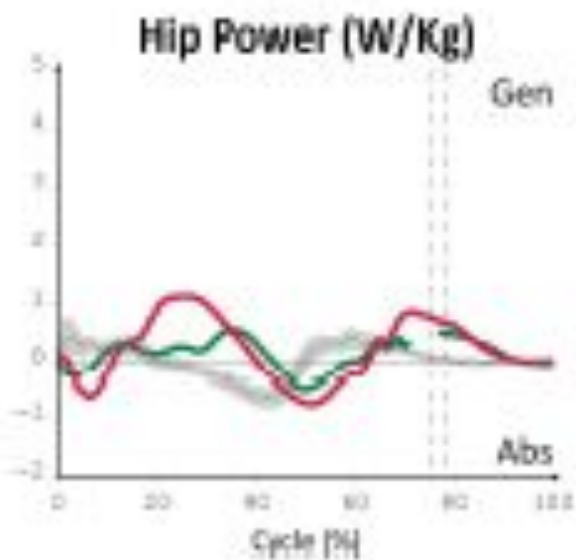
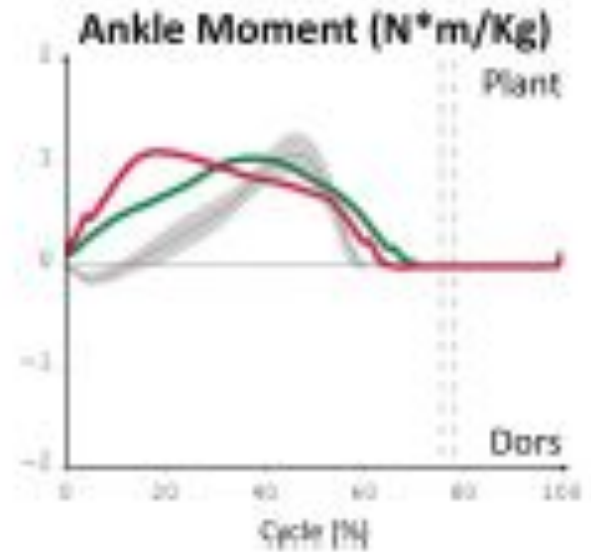
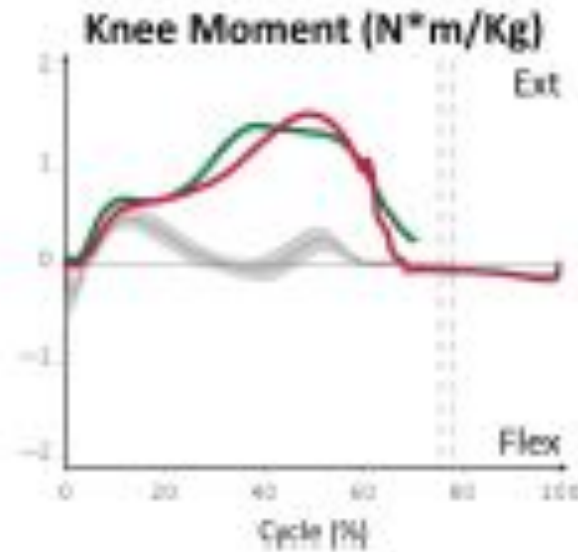
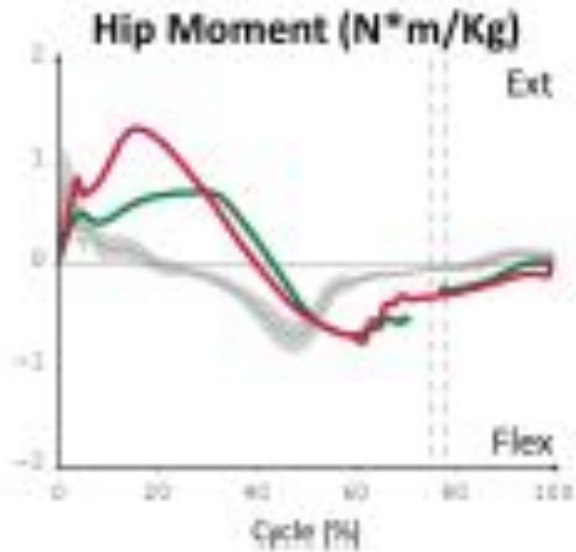
How do we do it?



FINAL RESULT



3D KINETICS





PATHOLOGICAL GAITS

- Abnormality in gait may be caused by –
 - Pain
 - Joint muscle range-of-motion (ROM) limitation
 - Muscular weakness/paralysis
 - Neurological involvement (UMNL/ LMNL)
 - Leg length discrepancy



TYPES OF PATHOLOGICAL GAIT

- Due to pain –
 - Antalgic or limping gait – (*Psoatic Gait*)
- Due to neurological disturbance –
 - Muscular paralysis – both
 - Spastic (*Circumductory Gait, Scissoring Gait, Dragging or Paralytic Gait, Robotic Gait[Quadriplegic]*) and
 - Flaccid (*Lurching Gait, Waddaling Gait, Gluteus Maximus Gait, Quadriceps Gait, Foot Drop or Stapping Gait,*)
 - Cerebellar dysfunction (*Ataxic Gait*)
 - Loss of kinesthetic sensation (*Stamping Gait*)
 - Basal ganglia dysfunction (*FestinautGait*)

WHAT CAN WE DO?

- **Muscle stretching/strengthening**
- **Mobilizations**
- **Foot orthoses**
- **Footwear**
- **Cerebral palsy- Therapy protocol, Orthoses, Botox, Casting, Surgery**

CONCLUSION

- **Thorough history**
- **Careful examination**
- **Identify the problem by gait analysis**
- **Discuss with patient and family**
- **Decide on course of action**
- **Prescribe appropriate treatment**



Indian Academy of Cerebral Palsy

Disability To Ability

THANKS

