



Computerized Gait Analysis: How Do We Move?

Online Gait Course Rebuild – 12 Years Later

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Context and Overview

Our objective is to update and improve our current Computerized Gait Assessment (CGA) online course, supported in a 2011 TLEF grant application, with a thorough needs assessment and backwards design approach.

This updated course will expand on the assessment of children with neuromotor issues, providing clinicians and students with insight into quantitative movement analysis.

Project Goals

Work with New Knowledge and Innovation at BCCH to:

1. Align learning outcomes, assessments and activities with an instructional design storyboard template.
2. Remove and replace Flash content with H5P; update plug-in tools; and create new media.
3. Review and update current case studies with an interactive learning component.

Future Work

We aim to continue our work by creating:

1. A new, online visual gait analysis course for children with pathological gait, with additional case studies.
2. A new, online course for standardized lower extremity pediatric assessment.

Access our Course!

This open-access course can be found on the [PHSA LearningHub](#), or scan this QR code!



Before

Kinematics

Kinematics describe body position and joint movement. By collecting position data from the markers on the child's body, the computer can calculate where each "segment" (pelvis, thigh, shank and foot) is in space.

Once segment positions are calculated we can then calculate the following kinematic variables:

- **Joint angles** - the angles between distal and proximal segments
- **Displacement** - the position changes of segments in space
- **Velocities** - the rate of change of segment displacements
- **Accelerations** - the rate of change of segment velocities



Strategy 1:

Interactive Assessments

Kinematic Variables

Once segment positions are calculated we can then calculate the following kinematic variables:

Drag the words into the correct boxes

- _____ ; the angles between distal and proximal segments
- _____ ; the position changes of segments in space
- _____ ; the rate of change of segment displacements
- _____ ; the rate of change of segment velocities

- Joint angles
- Velocities
- Accelerations
- Displacement

Check

Kinematic Variables

Once segment positions are calculated we can then calculate the following kinematic variables:

Drag the words into the correct boxes

- Joint angles ✓ ; the angles between distal and proximal segments
- Displacement ✓ ; the position changes of segments in space
- Velocities ✓ ; the rate of change of segment displacements
- Accelerations ✓ ; the rate of change of segment velocities

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After

Now, students are prompted to review the key terms via an interactive activity and receive immediate feedback. The activity was made using H5P (1). This promotes personalized, active learning.

Before

Definition of the Gait Cycle

Stance Phase Swing Phase

Initial Contact
During initial contact (the first 2% of the gait cycle), the hip is in flexion, the knee is in extension and the ankle is dorsiflexed and ready to accept weight. During this phase, both feet are still on the ground (double-limb support).

Click the circles at the top of the screen to see a step-by-step walkthrough, with explanations of each stage in the gait cycle.

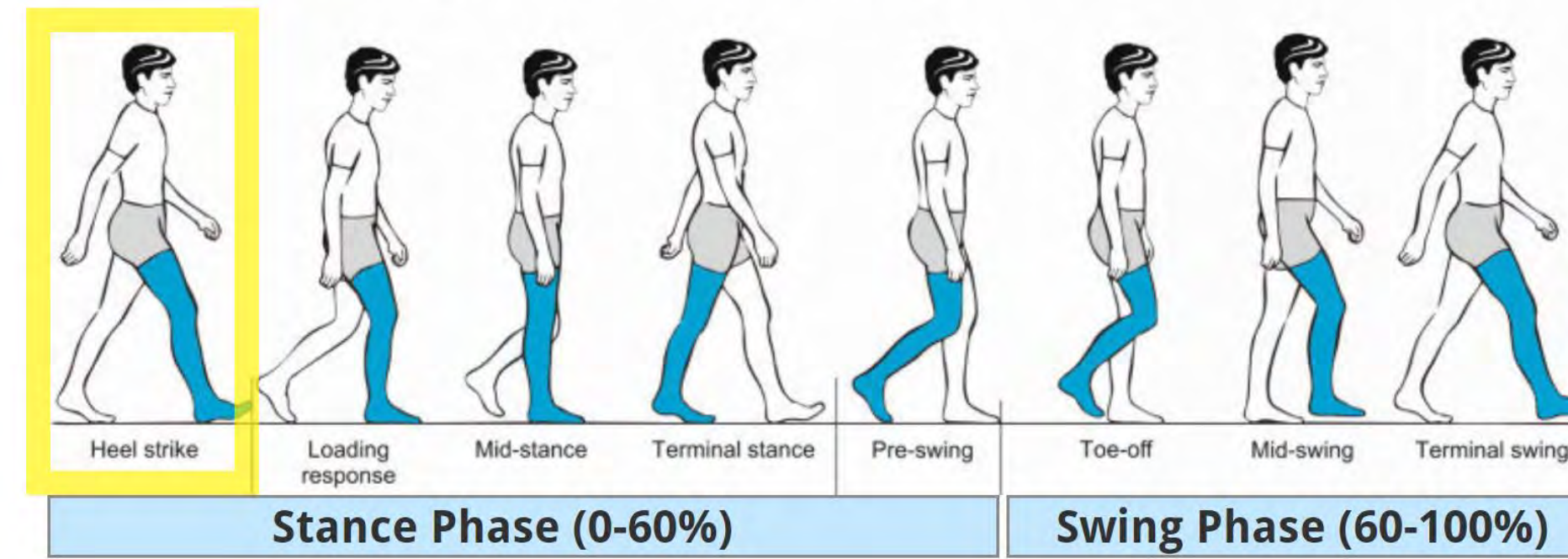
Strategy 2:

Clearly Segmented Content

Definitions of the Gait Cycle

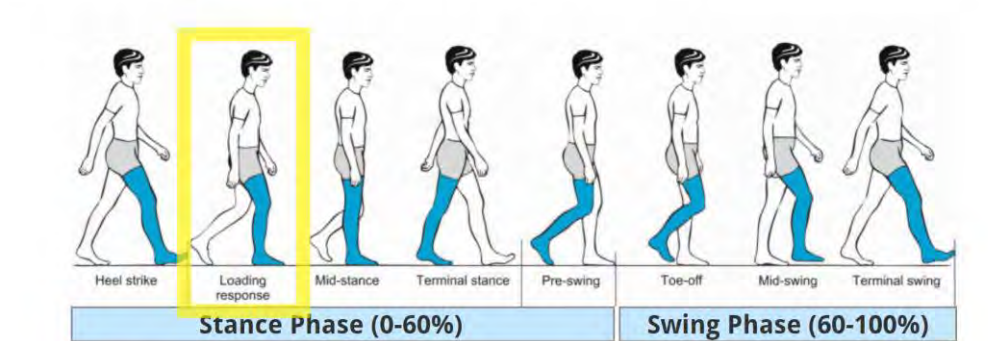
Initial Contact (Initial 2% of the gait cycle)

During initial contact (sometimes called heel strike), the hip is in flexion, the knee is in extension and the ankle is dorsiflexed and ready to accept weight. During this phase, both feet are still on the ground (double-limb support).



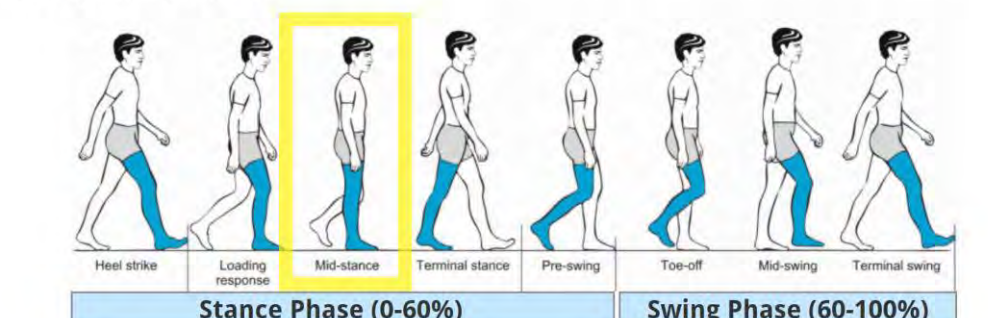
Definitions of the Gait Cycle

Loading Response (0-10% of the gait cycle)
During the loading response, body weight is beginning to be absorbed at the knee, and the ankle goes into plantarflexion to help absorb forces.



Definitions of the Gait Cycle

Mid-stance (10-30% of the gait cycle)
During mid-stance, the contralateral limb leaves the ground (the beginning of single-limb support), the ankle begins to dorsiflex and the opposite limb begins advancing through swing phase.



After

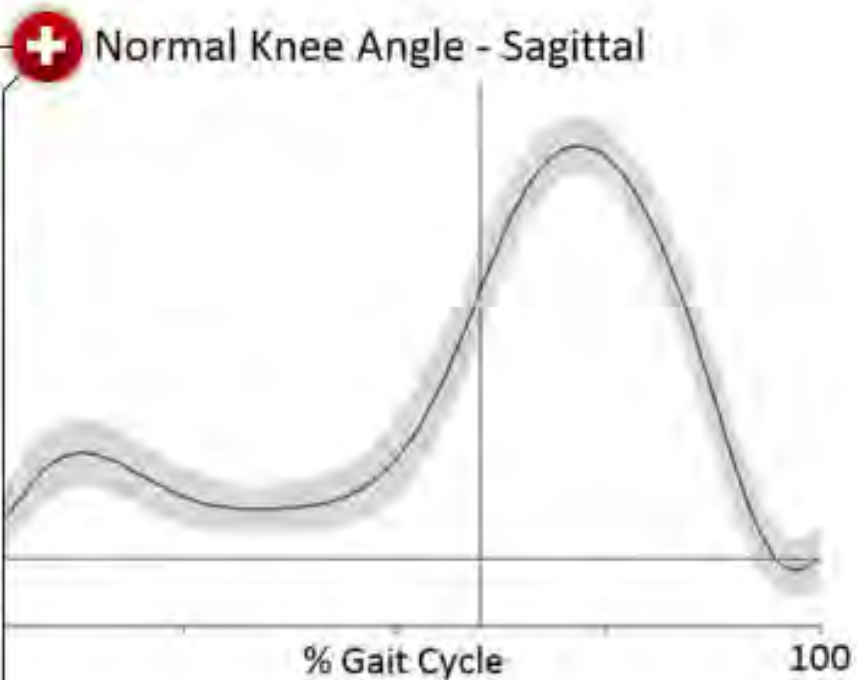
A diagram of the full gait cycle (2) is displayed while learning about each phase. Students are automatically shown the next phase to avoid accidental skips. This allows for easier navigation and less cognitive overload.

Before

Exploring Kinematics

Knee

The primary plane of motion at the knee is sagittal, as shown here. Just after initial contact, the knee absorbs forces and eccentric muscle forces resist excessive knee flexion. The knee is extended through mid-stance aid in propulsion and begins to flex passively in pre-swing as a result of hip flexion. Maximum knee flexion is achieved in mid-flexion swing and aids in foot clearance. In normal gait, coronal plane motion is minimal because the knee joint acts as a hinge. Transverse plane motion at the knee is also important, as is shows the rotational alignment of the shank relative to the thigh.



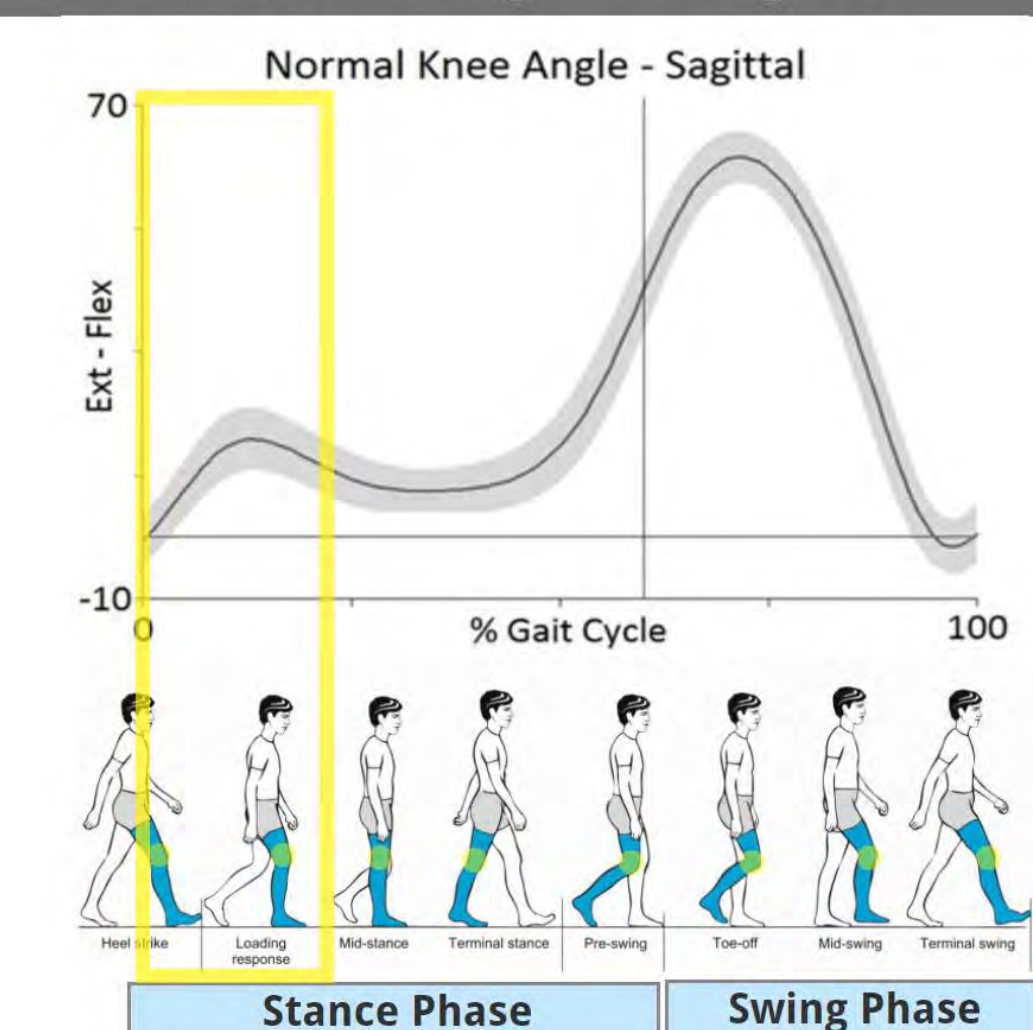
Strategy 3:

Relating Concepts in Data Visualization

Reading Kinematic Graphs for Gait: Knee Angle - Sagittal

The primary plane of motion at the knee is sagittal.

Stance phase: Just after initial contact, the knee absorbs forces and eccentric muscle forces resist excessive knee flexion

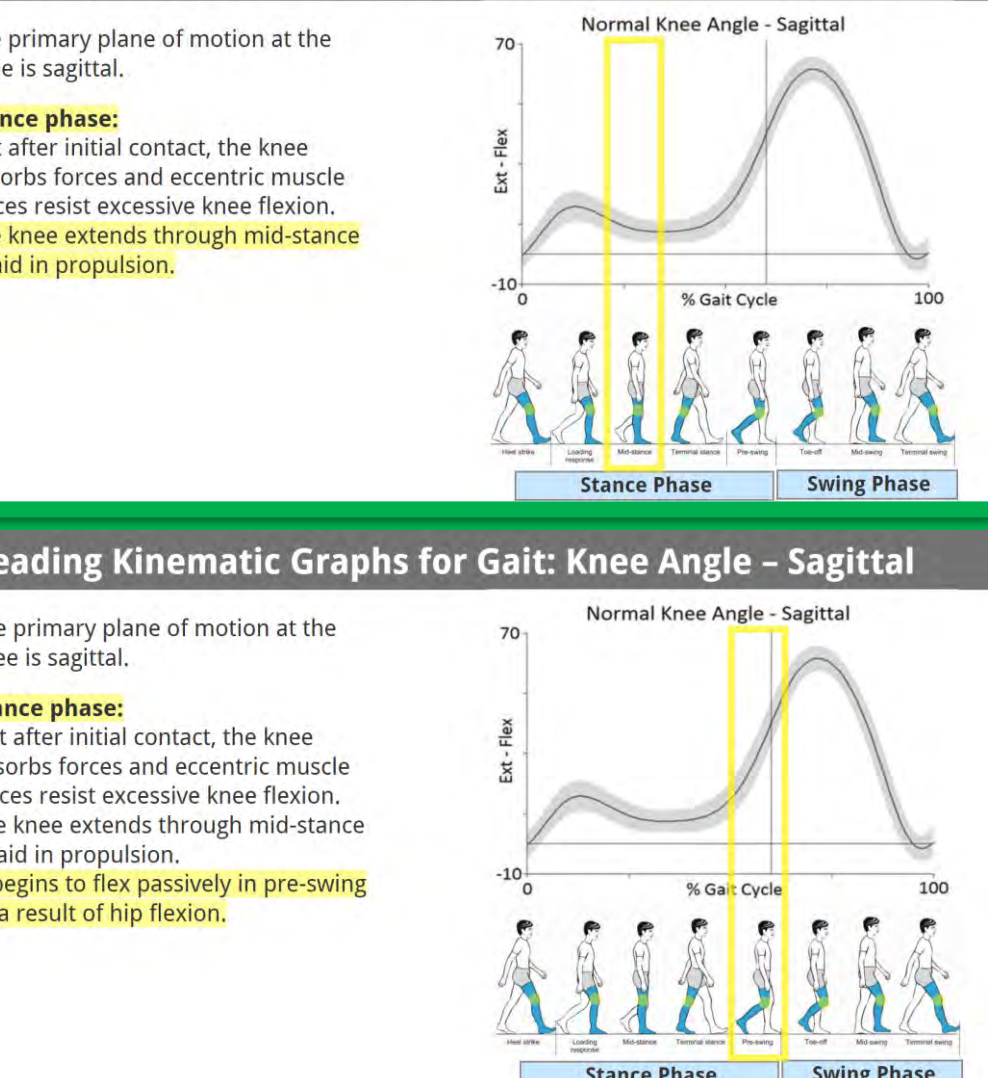


Reading Kinematic Graphs for Gait: Knee Angle - Sagittal

The primary plane of motion at the knee is sagittal.

Stance phase: Just after initial contact, the knee absorbs forces and eccentric muscle forces resist excessive knee flexion. The knee extends through mid-stance to aid in propulsion.

Swing phase: It begins to flex passively in pre-swing as a result of hip flexion.



After

Phases are separated and highlighted for easy reference on the graph. Gait cycle diagram displayed for easy reference, allowing students to recall what was learned and relate the concepts to the graphs presented.

References

1. H5P Resources <https://h5p.org/>
2. Gait Cycle Image: Pirker, W., Katzenschlager, 2017, <https://doi.org/10.1007/s00508-016-1096-4>

Acknowledgements

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