

The Basics of Gait

What does the gait cycle have to do with chiropractic or rehabilitation?

Well, most people walk at some point in the day, and most have walked into your office. If people cannot carry the changes you made on the table and incorporate them into walking, then what you do will have limited effect. Thus, understanding the gait cycle as it relates to rehabilitation, and how it can give you clues to the biomechanical faults present, is crucial.

An example is a loss of functional hip extension and chronic low back pain - sacroiliac joint dysfunction. This could be due to a myriad of reasons, including weak glutes, loss of ankle dorsiflexion or even a dysfunctional shoulder. Understanding how these seemingly unrelated body parts integrate into the kinetic chain is crucial, especially while moving upright through the gravitational plane.

One gait cycle consists of the events from heel strike to heel strike on one side. A step length is the distance traveled from one heel strike to the next (on the opposite side). Comparing right to left step lengths can give the evaluator insight into the symmetry of the gait. Differences in step length on the simplest level should cause the individual to deviate consistently from a straight line. (Technically, it should cause the individual to eventually walk in a large circle!) Often, compensations occur functionally in the lower kinetic chain and core to compensate for the differences in step length, to ensure that you walk in a straight line. It is these long-standing complex compensations that are the generators of many of our patients' complaints.

A stride length is the distance from heel strike to heel strike on the ipsilateral side (the distance covered in one gait cycle). Step width (base of gait) is the lateral distance between the heel centers of two consecutive foot contacts (this typically measures 6-10 cm). Foot progression angle is the angle of deviation of the long axis of the foot from the line of progression (typically 7-10 degrees).

Understanding some of our future articles will necessitate some common language. Let's begin with a typical walking gait cycle. There are two phases: stance and swing. It comprises approximately 62 percent of the gait cycle.¹ Jaqueline Perry^{2,3} uses this descriptive classification:

- Initial contact: When the foot first touches the floor.
- Loading response: Weight bearing on the loaded extremity from initial contact and continues until the opposite foot is lifted for swing.
- Midstance: The first half of single-limb support, beginning when the opposite foot is lifted until weight is over the forefoot.
- Terminal stance: Begins with heel rise and continues until the opposite foot strikes the ground.
- Pre-swing: When initial contact of the opposite extremity begins and toe-off ends.

Perry also describes three tasks to be performed during a gait cycle: *weight acceptance* (the limb is able to bear weight), *single limb support* (when weight is supported by one limb with the other in swing phase) and *swing limb advancement* (moving the opposite limb through space to become the next stance-phase leg). Physical impairment can occur in each one of these tasks, which will be discussed in future articles. According to Perry, progression of gait over the supporting foot

depends on three functional rockers:²

- Heel rocker: The heel is the fulcrum as the foot rolls into plantar flexion. The pretibial muscles eccentrically contract to decelerate the foot drop and pull the tibia forward.
- Ankle rocker: The ankle is the fulcrum and the tibia rolls forward due to forward momentum. The soleus (primarily) eccentrically contracts to decelerate the forward progression of the tibia over the talus. Ankle and forefoot rocker can be compromised by imbalances in strength and length of the gastroc/soleus group and anterior compartment muscles.
- Forefoot rocker: Tibial progression continues and the gastroc/soleus groups contract to decelerate the rate of forward limb movement. This, along with forward momentum, passive tension in the posterior compartment muscles, active contraction of the posterior compartment and foot intrinsics and windlass effect of the plantar fascia results in heel lift.

Heel strike, a traumatic deceleration event with the transfer of weight from one extremity to the other, creates shock, which must be attenuated. This is accomplished by four distinct mechanisms:

- Ankle plantar flexion: At heel strike, followed by eccentric contraction of the pretibial muscles to decelerate foot fall.
- Subtalar pronation: As the coefficient of friction between the calcaneus and the ground increases, the talus slides anterior on the calcaneus while plantar flexing, adducting and everting. This motion causes concomitant internal rotation of the lower leg. Both these actions cause a time delay, allowing force to be absorbed over a longer period of time.
- Knee flexion: This is a reaction to the heel rocker, forward motion of the tibia, and passive tension in the posterior compartment. It is slowed by eccentric contraction of the quadriceps, with the abdominals acting as a primary anchor.
- Contralateral pelvic drop: This is decelerated by the ipsilateral hip abductors (primarily gluteus medius) and lateral chain, as defined by Myers.⁴ It occurs as weight is suddenly dropped on the contralateral limb.

The rockers and shock attenuation are dependent on the integrity of the joints involved, their associated ligaments and cartilage, the functionality of the musculature crossing them and their neuromuscular integrity, along with appropriate cortical control of the actions. Being physical medicine practitioners, we understand that the anatomy and physiology cannot be separated and must consider these different components while evaluating the patient.

Swing phase is less variable in its classification. It begins at toe-off and ends at heel strike. It comprises 38 percent of the gait cycle.¹ In many cases, this phase shows functional compensations to what has improperly occurred in the stance phase, such as issues with balance, coordination and altered planes of progression of the upper and lower limbs. In this phase, there must be adequate dorsiflexion of the ankle and flexion of the knee and hip to allow forward progression.

Perry² defines the phases as:

- Initial swing: The first third of swing phase, when the foot leaves the ground until it is opposite the stance foot.
- Mid-swing: The time from when the swing foot is opposite the stance foot until the swinging limb is anterior to the stance-phase tibia.
- Terminal swing: From the end of mid-swing until heel strike.

Gait evaluation can range from casual observation to treadmill analysis. Both methods have their advantages and disadvantages. One affords normal progression on a static surface, but frequently has the patient at a distance from you, making observations challenging. The other affords you a constant distance view (treadmill), but alters some components of gait as the ground is moving,

which can cause acceleration and deceleration issues involving some of the phases discussed above. In gait and running analysis, there is an endless combination of possibilities to explain what you are seeing, often with many contradictions to what you think should be happening. The best way is to know what normal is supposed to be is to observe as many people as possible and try and make clinical correlations based on what you are seeing and what you know.

Now that you have an idea of what is supposed to happen in the gait cycle, you can begin to integrate what you are seeing into your working diagnosis and treatment program.

References

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