Dynamic Chiropractic

ORTHOTICS & ORTHOPEADICS

Gait Cycle Evaluation as a Component of Chiropractic Care

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Function and balance of the spine and pelvis depend on coordinated support from the feet and legs, especially during gait. It is because of this interdependence that doctors of chiropractic must consider the lower extremities when evaluating spinal problems and complaints. In many cases, there are no extremity symptoms, so examination of the gait cycle is often necessary.

Bipedal walking consists of two phases for each lower extremity: the swing phase (when the foot is off the ground) and the stance phase (when the foot is on the ground and bearing weight). The stance phase is the most important portion of the gait cycle, since this is when the foot becomes fixed to the ground and provides support for the pelvis and spine. Forces such as compression, rotation and shear are transmitted along this closed kinetic chain. It is during the stance part of gait, when the spine is being supported on the single fixed leg, that the biomechanics of the foot and ankle can interfere with chiropractic care. The three components of the stance phase are heel strike, midstance and toe-off. Each of these can be a contributor to spinal stress and persisting symptoms.

Heel Strike

As the heel contacts the ground, the calcaneus is inverted and the foot is supinated. The ground reaction force is transmitted into the foot at the heel pad and then the ankle joint absorbs some of the impact. The force of heel strike transmits a shockwave (a "transient") up the leg to the pelvis, the spine and into the skull. An experiment using human subjects found that normal walking produces around 5 Gs of force on the foot and ankle, and within 10 milliseconds of heel strike (faster than we can consciously respond) a shockwave produces a 0.5 G impact at the skull.[1] This is the equivalent of a 160-pound man being hit on the head by 80 pounds with each step. Running multiplies the impact of heel strike on the body about three times (the Rule of Three).[2] This force is a significant concern in patients with spinal problems and recurring subluxations; in particular, those with degenerative changes in the joints of the lower extremities and the spine.

Midstance

From heel strike to midstance, the foot undergoes a complex inward roll, primarily at the subtalar joint. This movement, called pronation, accommodates to variable ground surfaces and helps absorb the impact of heel strike. As the foot pronates during the stance phase of gait, there is a normal medial rotation of the entire leg into the pelvis. When the foot goes too far into pronation or stays in this position for too long, the increased rotational forces are transmitted up the leg into the pelvis and especially the sacroiliac joint.[3] In response, various compensatory pelvic subluxation complexes develop. These include pelvic tilts (usually anterior or to one side), innominate rotations (usually posteroinferior) and other complicated adaptations.

Toe-Off

The final aspect of stance phase starts with heel lift, which then progresses to toe-off and provides the propulsion needed to move into the swing phase. Inadequate propulsion adds to the work effort required for doing simple activities and increases oxygen consumption during normal walking.[4] Sports performance can be significantly hampered.

Reducing Musculoskeletal Stress

A properly designed, custom-made stabilizing orthotic will provide corrections and support during all gait-related activities

- Shock absorption from viscoelastic materials eases the impact at heel strike and reduces the abnormal forces on degenerated joints. Several studies have found that reducing the impact at heel strike by using a viscoelastic polymer insert will significantly decrease both foot and back symptoms.[5-7]
- The extent and speed of pronation is controlled during midstance to reduce the rotational forces that are transmitted up the leg into the pelvis and spine. Especially in heavier or more active patients, additional torsional rigidity must be supplied to prevent medial collapse.
- Viscoelastic support under the forefoot (especially the first two metatarsals) during toe-off reinforces the propulsive phase and reduces fatigue.

Always Consider the Lower Extremities

Spinal posture and alignment depend on the smooth functioning of the foot and ankle complex during gait. Researchers are now beginning to understand the intricate relationships that many doctors of chiropractic have treated empirically (and successfully) for decades. As one investigator commented, "The full rehabilitation of the back patient with chronic back pain must include re-education in the optimal use of the spine in walking."8 Whenever a patient is being treated for a spinal problem, we must always consider the importance of the lower extremities, evaluate the efficiency (or frequently, the inefficiency) of gait, and then provide the appropriate care and support.

References

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