Dynamic Chiropractic

ORTHOTICS & ORTHOPEADICS

Spinal Biomechanics: What Role Do the Feet Play?

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The importance of the feet to the normal biomechanical functioning of the spine often is overlooked. Because the feet are seldom symptomatic, busy chiropractors frequently overlook examining and, consequently, treating them. Often times, it's only when a patient does not respond as well as expected to care that the chiropractic physician begins to look for interference from the pedal foundation. Faulty foot biomechanics can have a negative impact on all supporting joints above the foot/ankle complex. A recent study concluded, "There are small, but important, intersegmental movements of the spine during gait."[1] Furthermore, an abnormal gait (no matter what the source) eventually will interfere with these important spinal segmental movements. This, in turn, can lead to serial postural distortions, muscular imbalances and spinal joint dysfunction.

The Foot/Spine Connection

When we stand, walk, dance, jump and run, the feet are the foundation to the spine and the rest of the musculoskeletal support system of the body. This foundation must bear the weight of the entire body. If there is insufficient support from the pedal foundation, the spine will be exposed to less than optimal gait mechanics, which eventually can cause spinal joint dysfunction, postural deviations and back pain. Recognizing and responding appropriately to faulty foot biomechanics will allow chiropractic physicians to more effectively care for their patients.

Abnormal stresses on the pelvis and spine can be the result of, but not limited to, excessive shock transmission, abnormal joint motion, abnormal foot proprioception or a functional short leg. The cause of all four of these problems often is located in the feet. When a part of the foot is not moving properly (either insufficient or excessive joint motion), the resulting forces produce effects along the whole kinetic chain. Researchers have found, "Alteration of normal foot mechanics can adversely influence the normal functions of the ankle knee, hip and even the back."[2]

Shock Transmission

In ideal standing, posture with even feet forms an angle of 30 degrees and a plumb line dropped from the sacral promontory falls midway between the feet onto a line between the navicular bones.[3] Pronation occurs when the superior aspect of the calcaneus tilts and rolls inward, which then brings the talus with it. This releases the navicular from arthrodial articulation with the talus and jeopardizes the medial longitudinal arch. When collapsed, it can begin serial distortion that may extend to the occiput.[4] If the biomechanics of a foot tend to function in either hyperpronation or excessive supination, excessive shock is transmitted to the spinal joints. A high arched or cavus foot with limited range of motion attenuates shock poorly, and a hypermobile flat foot also does poorly on shock attenuation because of its function near the end of the range of motion.[5] In either case, the forces may be felt in the joints of the pelvis and spine. In fact, enhancing shock absorption from the lower extremities may be one of the most significant long-term improvements that will be reported by patients with degenerative discs and spinal joints.

Light and his colleagues studied the "brief but sizeable deceleration transient, which travels up the human skeleton on heel strike during normal walking."[6] In their classic investigation, they found significant stress that could be reduced with the use of visco-elastic heel pads. Regarding the spine, they warned, "While the transients will load the majority of joints primarily in compression, shear stress will predominate in others, such as spinal facet and sacroiliac joints."[6] This may explain the rapid response of lumbosacral and sacroiliac pain with the use of orthotics that contains shock-absorbing materials.

Abnormal Joint Motion

When the foot and ankle biomechanically function in prolonged pronation, the entire lower extremity undergoes excessive internal rotation. This causes a range of altered biomechanics in the pelvis, sacroiliac joints and spine. Hammer has described the numerous consequences as follows: "Based on excessive internal femoral rotation due to hyperpronation, this may develop compensatory shortening of the iliopsoas, which would draw the spinal column downward, forward and rotate contralaterally. Unilateral iliopsoas involvement would cause a unilateral anterior pelvic tilt, while bilateral hyperpronation may result in an increased lordosis."[7] The result is recurring abnormal joint motion affecting the sacroiliac and lumbar spine joints. These forces can be decreased significantly with the use of an orthotic that controls hyperpronation.[8]

Altered Proprioception

Proprioceptors are the sensory organs located in muscles and joints that provide information to the central nervous system regarding the status, function and position of the musculoskeletal system. With several small joints, ample layers of connective and articular tissues, and both intrinsic and extrinsic muscles, the feet are very well supplied with proprioceptive nerve endings. When there is biomechanical dysfunction, it is probable that inaccurate neurologic information is sent to the CNS from the feet. This can have a detrimental effect on coordination and balance throughout the spine and pelvis.[9]

Dropped Pelvis

When there is a discrepancy in the length of the legs (whether anatomical or functional), the pelvis is lower on one side. Leg-length asymmetry will cause vertebral rotation, recurrent subluxation and possibly a functional scoliosis, which in turn, produces strains to the pelvic and low back structures. These strains can cause not only chronic pain[10,11] but also have been shown to result in specific degenerative changes.[12] The most common cause of a functional short leg is a lowered medial arch and excessive pronation. The study by Rothbart and Estabrook found a correlation factor of 0.97 between asymmetrical pronation and a pelvic tilt to the same side.[13] Because of these types of findings, it may be difficult to eliminate pelvic and spinal dysfunction without treating the feet.

What to Do

Every patient with spinal and pelvic-joint dysfunction should be checked for abnormal foot biomechanics. This evaluation can be quick and easy and is not painful to the patient. The feet may need to be adjusted so that numerous joints up the kinetic chain can move smoothly during each phase of gait. In addition, most patients with biomechanical foot problems will benefit from the long-term support provided by orthotics.

Conclusion

When a patient presents with spinal joint dysfunctions, especially ones that do not correct rapidly and completely, a search for contributing factors must include examination of the feet. Orthotics can be helpful in most cases needing long-term spinal stabilization. Even expertly applied, spinal corrections often will be only partially successful until the lower extremity problems are uncovered, corrected and supported for the long haul.

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