



ORTHOTICS & ORTHOPEADICS

Unlevel Shoulders: What's the Foot's Role?

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When we stand and walk there is a fine interplay between the movement of the lower extremities and the balancing of the spine. Normal gait causes predictable, repetitive motion to occur from the feet up to the head.¹ The accurate timing of the many fine muscle contractions required depends on stimuli from a symmetrical gait. Our lower extremities, and in particular the feet, have a significant effect on normal posture. Alignment and function of the pelvis, spine, shoulders and head are strongly influenced by pedal balance or imbalance. We now recognize that foot imbalances, such as excessive pronation and metatarsal arch collapse, cause postural problems with far-reaching effects that can include shoulder unleveling.

Foot Effects

Pelvic misalignments. As a foot pronates during the stance phase of gait, there is a normal inward (medial) rotation of the entire limb and pelvis. In persons who have excessive or prolonged pronation, this twisting movement is accentuated. The increased rotational forces are transmitted into the pelvis, and especially the sacroiliac joints.² In response, various compensatory pelvic subluxation complexes develop, including pelvic tilts (usually anterior or to one side), innominate rotations (usually postero-inferior), and other complicated adaptations. Until the excessive pronation is corrected with custom orthotic supports, only short-term relief can be achieved with chiropractic adjustments.

Functional scoliosis. The loss of arch height that occurs with excessive pronation allows the pelvis to drop to the more pronated side during stance and gait.³ The resulting pelvic tilt lowers the sacral base and drops the lowest freely moveable vertebra. A lateral curvature develops in response to the lack of solid support for the base of the spine. This "functional" scoliosis starts in the lumbar region, but can affect the entire spine. It is often first identified due to the presence of unlevel shoulders. In young patients, this type of curvature disappears when sitting or lying on the exam table. As patients age, the spine becomes less flexible, and functional curves become more fixed.

Muscle imbalances. Many chronic myofascial problems can begin with excessive foot pronation.

The associated gait abnormalities, neurological incoordination and asymmetrical structural stresses are often compensated by contracting the large stabilizing muscles of the spine and shoulders. This results in habit patterns with detrimental effects on movement, and eventual perpetuation of symptoms. Myofascial trigger points in the upper quadrant, chronically contracted shoulder muscles, and even thoracic outlet syndrome⁴ can develop when gait abnormalities continue.

Neurological Effects

With many small joints, connective and articular tissues, and both intrinsic and extrinsic muscles, the feet are well supplied with proprioceptive nerve endings. Mechanoreceptors in the joints, along with the muscle spindles of the foot muscles, are responsible for the positive support reflexes and a variety of automatic reflexive reactions.⁵ The position receptors in the feet, spine, and especially the neck (head-righting reflexes) must coordinate smoothly to maintain postural equilibrium. Difficulty in keeping optimal postural and shoulder alignment, and/or problems with excessive postural sway, are frequently caused by inaccurate information sent by spindle sensors in chronically strained muscles or by joint mechanoreceptors.⁶ Whenever there is an unequal amount of support from each leg during weightbearing stance (due to either an anatomical or a functional shortening), posture will definitely suffer. This results in an uneven foundation for the pelvis and the spine, causing postural shifts (such as unlevel shoulders) in response.

Coordination of the lower extremities during gait is a critical aspect of shoulder function.⁷ At the same time that gravity and ground reaction forces are affecting the legs and feet, the torso and shoulder are also responding. With each step, the scapula reacts to opposite-leg-loading by tipping anteriorly in the sagittal plane, rotating upward in the frontal plane, and gliding around the ribcage in the transverse plane (protraction). This reaction produces the appearance of a hunched and forward-rounded shoulder, and can be described as "shoulder pronation." The biomechanical and neurological processes that link shoulder pronation to lower extremity pronation on the opposite sides help us understand how unlevel shoulders can be indicators of asymmetrical foot function.

The Importance of Gait



Figure 1: *Pronation and internal rotation of the opposite leg with external shoulder rotation.*

As the leg is loaded in gait, trunk side-bending occurs to the loading leg. The lumbar spine rotates away from the loaded leg, and a balancing rotation occurs in the thoracic spine to the same side as the loading leg. The scapula then slides forward on the ribcage into the protracted position. It is the eccentric loading of the periscapular muscles that controls the scapular reaction, and the shoulder is now ready to retract with efficiency. The entire relationship of the shoulder and thoracic spine is driven by the cross-crawl neurological reaction to gait.

There are also common hip motions that can function as "cheaters" for the shoulder. This occurs when the shoulder muscles are weak, fatigued or overloaded. The strength of the large muscle mass around the hip can substitute and alter the mechanics to the weakened shoulder muscles' benefit. For instance, transverse plane activity (such as external rotation of the shoulder with exercise tubing) is assisted by opposite hip internal and external rotation (Fig. 1). This means that excessive pronation on the opposite leg can interfere significantly with normalization of the neuromuscular balance between the internal and external rotator muscles of the shoulder. To address this, custom-made, corrective orthotics that reduce or limit pronation are often needed to fully rehabilitate shoulder injuries and chronic symptoms.

Conclusion

Because a smooth and symmetrical gait is tied so closely to proper vertebral function, biomechanical problems in one or both feet can interfere with postural alignment patterns. Many spinal and postural complaints, including shoulder unleveling, have foot dysfunction as initiating or an associated factor.

While the feet may seem far away from the upper spine and shoulders, they are intimately connected in several ways. Structural and dynamic gait, and neurological factors clearly reveal this interrelated and integrated system. Posture, balance, coordination, and efficient musculoskeletal function all depend on the smooth functioning of the foot and ankle complex. Researchers are now beginning to understand the intricate relationships that many doctors of chiropractic have treated empirically (and successfully) for decades. Whenever a patient demonstrates a postural imbalance with unlevel shoulders, we must always consider the importance of the lower extremities, and the feet in particular.

References

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