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Rethinking Foot Dysfunction: How weak foundations create pain up the chain

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Narrative: The foot is one of the most neurologically dense and mechanically sophisticated regions of the body. dysfunction of the feet can lead to pain and dysfunction in specific patterns elsewhere in the body.

The body is organised in myofascial lines, not isolated muscles. Tension, force, and sensory information travel along predictable pathways. Some of the key myofascial lines connected to the feet are the superficial back line, the deep front line, the spiral line, and the lateral line.

The feet are the foundation of the body's stability to the ground, and when they are dysfunctional, the rest of the kinetic chain may compensate.

This is leading clinicians to ask if there should be an increased role in foot rehabilitation.

Indexing terms: Chiropractic; orthotics; foot rehabilitation; fascial planes; compensation.

Introduction

Chronic pain is defined as pain lasting for over three months (13w). Approximately one in four adults worldwide experience chronic pain. Low back pain is the most common and disabling pain condition in the world estimated to impact approximately 7-12% of the global population, which equates to up to 750 million people at any moment. The assumption that the problem must be where the pain is has been contested over the last few decades as more research on biomechanics emerges.

> *… feet are the foundation of the body's stability to the ground, and when they are dysfunctional, the rest of the kinetic chain may compensate …'*

Stability is built from the ground up which begs the question, how much might foot dysfunction relate to pain further up the kinetic chain? If the foundation of the body is unstable, it is reasonable to assume the rest of the body may compensate, resulting in pain. The foot is often described as a passive structure consisting of a platform and an arch to cushion impact.

> In reality, the foot is one of the most neurologically dense and mechanically sophisticated regions of the body.

Each foot consists of 26 bones, 33 joints, over 100 muscles/tendons/ligaments, and thousands of mechanoreceptors feeding constant information to the brain. Of significant importance are the intrinsic foot muscles which are small, deep muscles that originate and insert entirely within the foot. These small muscles stabilise the arch, regulate load transfer, fine-tune balance, and help inform the brain where the body is in space.

When the intrinsic muscles of the foot are weak or inhibited, it can lead to excessive pronation or rigidity, delayed push-off during gait, altered timing between stance and swing phases of gait, and reduced sensory input from the ground. As a result, the nervous system will recruit alternative muscle patterns to compensate for improved stability. It is these compensation patterns that are theorised to cause pain and dysfunction up the kinetic chain.

Myofascial planes

Research on myofascial planes theorises how dysfunction of the feet can lead to pain and dysfunction in specific patterns elsewhere in the body. The body is organised in myofascial lines, not isolated muscles. Tension, force, and sensory information travel along predictable pathways. Some of the key myofascial lines connected to the feet are the superficial back line, the deep front line, the spiral line, and the lateral line.

The fascial lines

The superficial back line supports extension, anti-flexion, and postural support against gravity. It runs from the plantar surface of the foot, the posterior leg, the spine, up to the scalp fascia. Key muscles groups included in the superficial back line are the plantar fascia, gastrocnemius, soleus, achilles tendon, biceps femoris, semitendinosus, semimembranosus, sacrotuberous ligament, iliocostalis, longissimus, spinalis, thoracolumbar fascia, splenius capitis, suboccipitals, and the epicranial fascia.

The deep front line supports core stabilisation, breathing, autonomic integration, proprioceptive control, and vertical postural alignment. Key muscle groups included in the deep front line are the tibialis posterior, flexor hallucis longus, flexor digitorum longus, adductors of the thigh, pectineus, psoas major, iliacus, pelvic floor muscles, transversus abdominis, diaphragm, mediastinal fascia, longus colli, longus capitis, and the scalenes.

The spiral line is associated with rotational control, counter-rotation during gait, balance stabilisation, and scoliosis patterning. The major muscle groups associated with the spiral line are the tibialis anterior, peroneus longus, iliotibial band, tensor fasciae latae, gluteus maximus, external oblique, internal oblique, serratus anterior, rhomboids, splenius capitis. The spiral line is theorised to wrap around the body in a figure-8 pattern.

The lateral line is associated with frontal plane stability, single-leg balance, pelvic stabilisation, and lateral weight shifting. The major muscle groups associated with the lateral line are the peroneals, iliotibial band, gluteus medius, gluteus minimus, internal oblique, external oblique, quadratus lumborum, intercostals, sternocleidomastoid, and the scalenes.

When there is dysfunction in the feet, each of these myofascial lines can compensate to improve stability throughout the kinetic chain. The superficial back line can increase activity in the calves, hamstrings, and lumbar spine extensor muscles which may result in altered neck and head posture. The deep front line can lose efficiency due to foot dysfunction resulting in hip instability, pelvic asymmetry, breathing pattern alterations, and reduced postural endurance. The spiral line can compensate resulting in internal rotation of the tibia, knee valgus, hip internal rotation, pelvic rotation, and contralateral shoulder and neck tension. The lateral line can increase tension in the peroneals, hip abductors, and iliotibial band to improve frontal plane control due to foot dysfunction.

When compensation fails

While these compensation patterns may be necessary to assist with stability throughout the kinetic chain, when intrinsic foot muscles fail to do their job appropriately, larger muscles take over roles they are not as efficient at, overall joint loading increases, movement efficiency drops, and the likelihood of pain outside of the foot increases. In this model, treating pain at the location of pain without restoring the foundation of the kinetic chain and the cause of the dysfunction may lead to at best short-term relief and long-term recurrence.

While orthotics are commonly the therapy of choice for foot dysfunction, a growing number of researchers and clinicians are asking if there should be an increased role in foot rehabilitation. While orthotics can provide external support and may be beneficial for patients, it does not restore neurological and biomechanical control. With appropriate foot rehabilitation it would be expected to see improvement in arch control, ground reaction forces, and sensory input to the brain resulting in less compensation throughout the kinetic chain and an improvement in pain.

Conclusion

Chronic pain may be viewed in a systems-based approach analysing the whole kinetic chain rather than solely the location of the pain. The feet are the foundation of the body's stability to the ground, and when they are dysfunctional, the rest of the kinetic chain may compensate.

These compensations can result in altered global and regional biomechanics, pain, breathing abnormalities, and gait dysfunction. Supporting the feet through targeted rehabilitation, not just external bracing, offers a way to restore control from the ground up. By improving intrinsic muscle strength of the feet, load distribution, and sensory feedback, the need for global compensation may improve resulting in improved pain.

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About the author

Dr Traster is a globally recognised expert in the field of neurological rehabilitation. He lectures and consults for doctors of all specialties across the world relating to patients with a variety of neurological disorders. The conditions Dr. Traster works most with are dizziness, dysautonomia, brain injuries/concussions, chronic pain, headaches, walking/balance disorders, movement disorders, cognitive disorders, and developmental disorders.

Dr Traster was personally mentored as a student by the world-renowned Dr Frederick Carrick. Dr Traster is currently an assistant professor for the Carrick Institute and leads their Vestibular Rehabilitation Program as well as lecturing on other topics. Dr Traster was named Instructor of the Year by the Carrick Institute in 2018. Dr Traster also has over 45 peer-reviewed case studies published in mainstream neurology medical journals. Dr Traster received a Bachelor of Science degree from Boston University, a Chiropractic degree and a Masters degree from Life University, and holds the highest level of education in Functional Neurology by attaining his diplomate in Chiropractic Neurology / Functional Neurology through the Carrick Institute for Graduate Studies.