Dynamic Chiropractic

ORTHOTICS & ORTHOPEADICS

The Pedograph as a Window to the Gait Cycle

Have you ever studied footprints on the beach or looked at the print left by a wet foot when you got out of the water?

These are some of the most primitive types of pedographs. The pedograph, first described by Harris and Beath[1] in 1947, is a rubber mat surface with multiple, protruding, small grid lines on one side. When covered with ink, it imprints an underlying sheet of paper as weight (usually a foot) passes over it. Relative plantar pressures are indicated by the size and density of the inked area,[1,2,3] creating a "footprint" and reflecting passages of force through the foot at that point in time.

Pedographs have fallen into and out of usage over the years, often discarded for more expensive technology such as pedobarographs, individual pressure sensors, and pressure-sensitive mats, which have computer interfaces and can provide many useful measurements and calculations to assist the clinician with a diagnosis. These systems, although more precise in some ways (a controlled, reproducible testing procedure), are often thousands of dollars, require a computer along with the necessary skills, and have a substantial learning curve.

In contrast, the pedograph is simplistic, inexpensive and reliable. It only requires that the user have an intact visual pathway, cerebral cortex and knowledge of the events occurring in the gait cycle. With some practice and a good knowledge base, the subtle nuances (often undetected with high-end, computer-driven plantar-pressure devices) detected by the sensitive pedograph can offer information critical to a precise diagnosis and give solid clues to gait flaws and compensations. With minimal training, reproducible "prints" can be attained for analysis in light of your clinical findings. They also make wonderful educational tools for your patients.

An essential part of a comprehensive patient evaluation should include examination of the entire kinetic chain, both in a static and dynamic fashion. Often what you see statically is either directly translated to or compensated for in the dynamic evaluation. (It is important to note that many of the available foot scan units available from orthotic companies scan a patient in a static, standing position and give little information on how the feet and lower limb dynamically engage the ground during movement.) The pedograph is a useful visual tool representing a two-dimensional image of tri-dimensional motion, and you are seeing the end product and compensation (or lack thereof) of the individual's mechanics at that point in time. Because the specificity of what you are seeing refers to a particular point in time, technique and reproducibility are of paramount importance. Prints should be performed several times to ensure what you are looking at is, in fact, what you are looking at, and not movement artifact because of the way the patient stepped on to or off of the mat.

Here is a brief case study: a 40-year-old female marathoner with a history of chronic, right sacroiliacpain, which worsens after runs. There is a distinct difference betweenthe right and left dynamic plantar pressures. This is a fairly consistent pattern in the SI-joint patients. The patient has a heavy print over the right second and third metatarsal heads, with very little under the first ray complex or hallux (i.e., pressures are more lateral on the foot). The left foot shows that the pressures are very medial, with good pressures under the hallux, but none under the first

metatarsal head. This patient is shifting her weight from left to right. This is substantiated by the slight external rotation of the right foot, and thus the entire limb (although not seen well on the prints), to accommodate the right frontal-plane challenge. Of clinical importance, turning the right limb externally may help use the quadriceps with the hip abductors to protect falling to the right. As she progresses over the right foot, she runs out of adequate hip extension and thus is unable to get over to the first ray complex and hallux. As this needed range is challenged, but not met, the patient's strategy is to spin the rear foot inward (technically external rotation), forcing the forefoot into supination-inversion and causing propulsion off of the second and third metatarsal heads. Some call this an "adductor twist" gait, but it has nothing to do with the adductor hip muscle group.

In summary, her attempt to move forward in the sagittal plane with limited right hip extension forces her to externally rotate the limb, toe-off more laterally and gain the desired hip extension through the low back instead of the hip, giving her the chronicSI-joint irritation/loading.

This is not the only compensatory strategy to deal with this problem. There are others that can be used, but these will be left for another case presentation. In similar case scenarios, it would be prudent to evaluate the neuro-integrity of the abdominal wall, glutes, hip extensors and internal hip rotators. Optimal cooperation of these functional units often can collectively produce the desired hip extension and internal rotation necessary to begin reducing the gait compensation described above.

With a pedograph, seeing is believing. When you have objective data of how an individual moves through space and how their joints and motor systems help them accomplish that, you have a better appreciation for the type of therapy that is most appropriate. In essence, joint function deemed appropriate on the table does not necessarily translate to appropriate joint function when the feet are on the ground. In the hands of a skilled clinician, seeing abnormal plantar pressures tells you where the biomechanical faults may lie and thus, where manipulation may be appropriate, which muscles need strengthening and where neuro-motor coordination is lacking and gait rehabilitation is needed.

References

1. Harris WC, Beath T. Canadian Army Foot Survey. National Research Council, 1947.
2. Shipley DE. Clinical evaluation and care of the insensitive foot. *Phys Ther,* 1979;59(1):13-8.
3. Waerlop I, Allen S. *Pedographs and Gait Analysis: Clinical Pearls and Case Studies.* Victoria, BC, Canada: Trafford, 2006.

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