there can be little doubt that the human foot is a marvel of design and engineering. Our feet allow us to stand for long periods, as well as move efficiently and at various speeds over many types of surfaces without pain or injury. They also must remain functional and appropriately flexible for the lifetime of the individual, or pain and disability will result. However, the feet are vulnerable to structural deficits, such as malalignment of bones and connective tissues leading to excessive pronation or supination. If there is excessive flexibility, for example, inefficient function could use up more energy, and the result would be inappropriate fatigue.

Can abnormal foot biomechanics result in more difficult physical functioning? We can hypothesize that not having an arch would make push-off less effective, since the foot does not become the needed “rigid lever” at toe-off. This, therefore, would make walking more inefficient, and more energy consuming. The end result would seem to be more energy usage, and greater fatigue than necessary from walking. Several studies have provided information to help answer this question. These results are important to all chiropractors, regardless of their patient populations.

The High Cost of Arch Collapse

Three researchers with backgrounds in physical medicine, physical therapy, and rehabilitation decided to investigate this fatigue hypothesis. Their stated goal was to perform a “comparative study...to assess the effects of arch support on oxygen consumption.” The study’s 40 participants were women between the ages of 18 and 38 years. All were in general good health, with no foot or lower extremity complaints. From weightbearing x-ray measurements, 20 women were selected who met the diagnostic criteria of flat feet. The other 20 women were used as a matched control group.

Conducting the tests. All subjects had several physiological parameters tested — at rest, while walking on a treadmill at three levels of speed and incline, and after recovery. The measurements included ECGs, systolic and diastolic blood pressures, pulse rates, and oxygen consumption. The energy cost of walking was calculated by multiplying the milliliters of oxygen consumed each minute by the weight of the subject in kilograms. This initial test provided the baseline for all women in the study.

The 20 women with flat feet were provided with custom-made arch supports, which they wore full-time for two weeks. At that point, the same testing procedures were again performed on all subjects, with the experimental group wearing their arch supports.

What the results showed. The control group showed
no differences in any of the measurements from the first test to the second test. Significant differences were seen in the walking and recovery measurements of the experimental group (those wearing the arch supports). Their heart rates were significantly slower, their systolic blood pressures were lower, the consumption of oxygen was less, and the calculated energy cost was much less. These differences were most obvious at the faster walking speeds and the higher inclines, as could be anticipated.

Support makes a difference. A control group was used, since it was possible that re-testing two weeks later might demonstrate improved performance because the subjects were more experienced with the test procedures. In this study, the control group did not show any significant change between the two tests. The significant improvements in physiological performance in the experimental group can be confidently ascribed to the use of the arch supports. The study’s authors state that “oxygen consumption can be decreased in patients with flat feet simply by applying a suitable arch support.”

But what is a “suitable” arch support? The researchers took weightbearing imprints of each experimental subject’s feet, made several measurements, and built a support of the medial arch from polyethylene. They then inserted this custom-made arch support into the leather of the shoe to prevent displacement. So, in this study, these flexible orthotics were built based on a “weightbearing, functional position” image of the foot.

**Golfers and Fatigue Reduction**

A more recent study used “experienced golfers with reported handicaps of 10 or less,” many of whom were teaching or touring professionals. The investigators wanted to determine whether the use of flexible, custom-made orthotics influenced gait to the extent that it reduced fatigue and its effects on objective golf-related activities.

Collecting data. Each subject completed a nine-hole round of simulated golf at the test site. The participants walked the course in golf shoes and carried their clubs. Gait was evaluated by measuring pelvic rotation and stride length before and after each round of golf. After an initial round of golf and baseline data collection, all participants were fitted with custom-made, flexible orthotics, which were then worn every day for six weeks. Re-testing then occurred, after there had been sufficient adaptation time for the orthotics.

Outcomes. Use of the custom orthotics was associated with a statistically significant increase in pelvic rotation during gait and a reduction in the effects of fatigue associated with nine holes of simulated golf. Stride length was also increased. Additionally, when using the orthotics, right and left pelvic rotation became objectively more symmetric. These effects showed the benefits of orthotic support on even expert golfers walking a nine-hole course. Previous studies had demonstrated the beneficial effects on balance and proprioceptive symmetry, as well as on club-head speed, in golfers when wearing custom-made, flexible orthotics.
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Posture, balance, coordination, and efficient musculoskeletal function all depend on a smooth gait and normal foot flexibility and stability during normal daily activities. Lack of support from the foot can impede function and require more physical effort. When patients complain of difficulty in walking, inability to stick to an exercise program, or just have generalized fatigue, an increase in performance and a reduction in fatigue can be anticipated when the foot is supported by a well-made custom orthotic.

References

About the Author
Dr. Brian Jensen graduated from Palmer College of Chiropractic in 1987. He speaks on a wide variety of topics, including orthotic therapy, posture, structural preservation, breaking free of the medical model of health care, and innovations in nutrition. Dr. Jensen is currently the Associate Director of Professional Education at Foot Levelers, Inc.