Dynamic Chiropractic

ORTHOTICS & ORTHOPEADICS

Fatigue and Foot Function

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The human foot is an engineering marvel; it allows us to stand for long periods, walk, run, and jump efficiently over many types of surfaces without pain or injury. It also must remain flexible and functional for the lifetime of the individual, or pain and disability will result.[1] If there were excessive flexibility, however, inefficient function could use up more energy, and the result would be inappropriate fatigue.

Do abnormal foot biomechanics result in more difficult physical functioning? Intellectually, 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 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 that may help answer this question. These results are important to all chiropractors, regardless of their patient populations.

Energy Cost of Walking With Flat Feet

Three researchers who wanted to investigate this fatigue hypothesis come from respective backgrounds in physical medicine, physical therapy, and rehabilitation. Their stated goal was to perform a "comparative study ... to assess the effects of arch support on oxygen consumption."[2] The participants were 40 women between the ages of 18 and 38. They were all in general good health, with no foot or lower extremity complaints. Based on weight-bearing X-ray measurements, 20 women were selected who met the diagnostic criteria of flat feet. The other 20 healthy women were used as a matched control group.

Test procedures. 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.

Results. 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, their consumption of oxygen was less, and their calculated energy cost was much less. These differences were most obvious at the faster walking speeds and the higher inclines, as could be anticipated.

Discussion. A control group was used, since it was possible that retesting two weeks later might demonstrate improved performance, because the subjects would be more experienced with the test procedures at that point. In this study, the control group did not show any significant change between the two tests. The significant improvements in physiological performance seen 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? These researchers took weight-bearing imprints of each 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 "weight-bearing, functional position" image of the foot.

Energy and Gait in Expert Golfers

Another study used "experienced golfers with reported handicaps of 10 or less."[3] Many of the participants 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 to assess its effects on objective golf-related activities.

Test procedures. 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. Retesting then occurred, after there had been sufficient adaptation time for the orthotics.

Results. Use of the custom orthotics was associated with a statistically significant increase in pelvic rotation during gait, even after accounting for the effects of fatigue. Stride length was also increased. Additionally, when using the orthotics, right and left pelvic rotation became objectively more symmetric. These effects show the benefits of orthotic support, even on expert golfers walking a nine-hole course. Previous studies have demonstrated the beneficial effects on balance and proprioceptive symmetry,[4] as well as on club-head speed,[5] in golfers when wearing custom-made, flexible orthotics.

Conclusion

Posture, balance, coordination, and efficient musculoskeletal function all depend on 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 generalized fatigue, an increase in performance and a reduction in fatigue can be predicted when the foot is supported by a well-made custom orthotic.

References

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