

Biomechanics and Cute Shoes

By Peter Slavin

High heels are getting ever higher, with taller platforms and spikier heels. But woman-kind was not designed to walk on stilts. The musculoskeletal system takes a beating, and ergonomic experts cringe.

“With heels two inches or higher, your foot slides forward, cramming your toes into the front of the shoe. That can cause hammer toes, a deformity in which the toes curl at the middle joint,” wrote Jeffrey Brault, D.O., P.T., in an Aug. 19, 2006 article in *The Eagle* newspaper. “If you wear them frequently, stilettos can contribute to permanent bunions...at the base of your big toe. They can also contribute to other foot problems including corns, calluses and toenail problems,” said Dr. Brault, who works at the Mayo Clinic’s Physical Medicine and Rehabilitation Department.

“Stiletto heels also change the mechanics of your gait,” he added. “That tiny heel hits the ground with a force several times your body weight. They can cause pain in your knees. Stiletto heels change your center of gravity, meaning you have to arch your back to stay balanced. That arching can cause lower back pain.”

Three industrial engineering professors teamed up to research the topic in an article titled “Biomechanical Effects of Wearing High-heeled Shoes,” in the December 2001 edition of the *International Journal of Industrial Ergonomics*. “As heel heights increased, the



D. Casey Kerrigan, a medical doctor and engineer, designs and manufactures women’s shoes in her factory in Virginia.

trunk flexion angle decreased significantly,” they wrote. “Similarly, tibialis anterior EMG (electromyography), low back EMG and the vertical movement of the body center of mass increased significantly while walking with high-heeled shoes. Due to these added stresses,” they concluded, “wearing of high heels should be avoided.”

To D. Casey Kerrigan, M.D. — a Harvard Medical School graduate known for her groundbreaking research on gait and the effects of footwear — the big problem is that high heels put extra torque on knee joints, causing many women to develop osteoarthritis. She discovered the link between the two.

Dr. Kerrigan is an engineer as well as a doctor. She was a tenured professor of mechanical and aerospace engineering at the University of Virginia, and chair of the university’s Physical Medicine and Rehabilitation Department. She studied gait for 20 years after running long distance in college. Two years ago, she left her academic career to develop an ergonomically superior women’s shoe for walking and running. She

now runs a factory in Charlottesville, Va., that manufactures her line of shoes, called OESH, which is “shoe” with the letters rearranged.

She calls OESH a breakthrough in footwear engineering. Her shoe is designed to compress and release, not at the moment of striking the ground as other shoes do, but when the foot is fully planted, so that the shoe synchronizes with the rise and fall of forces on the body from the foot’s impact. This puts much less stress on the joints. In addition, carbon fiber cantilevers in the sole give the wearer a sense of a springy, giving surface.

The shoes — for women only — are manufactured differently, too, using computer-automated processes and robotics. She says her factory is really “an engineering lab.” She employs half a dozen people and provides internships for students in various fields. This year, she has 40 UVA engineering undergraduates working in teams on seven projects, for course credit.

Dr. Kerrigan says she’s been offered millions for her patent but cares less about making money than making the best shoe possible. ■

