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Why walking flat-footed hurts habitual high-heels wearers

The effects of wearing high heels on women's legs

When it comes to shoes, some women will go through hell for a pair of Jimmy Choos. But what effect does wearing high heels have on our bodies? Clinicians have known for a long time that if you hold a limb in a shortened position over an extended period, the muscles shorten. High-heeled shoes push our heels up, which made Marco Narici from Manchester Metropolitan University wonder whether wearing heels on a regular basis could shorten our calf muscles. According to Narici, there was some anecdotal evidence that something changed because secretaries in the 1950s complained about discomfort when they took their heels off and walked flat-footed. 'I thought it was an experiment which was inadvertently being done by women. What we could do was test high heel wearers to see if we could find some changes in the calf muscle,' says Narici, who publishes his results on 16 July 2010 in the *Journal of Experimental Biology* at <http://jeb.biologists.org>.

At that time, Robert Csapo, from the University of Vienna, Austria, was visiting Narici's Active Lifespan Lab, so Narici and Costis Maganaris asked Csapo to test the theory. Placing an advert in the Manchester Evening News asking for volunteers ranging in age from 20 to 50 years who had regularly worn 5-cm high heels for 2 years or more, Csapo attracted 80 recruits, which he whittled down to a final group of 11 who felt uncomfortable walking without their heels. Then he recruited a second group of women who did not wear high heels and teamed up with Olivier Seynnes to look at the internal workings of both groups' calf muscles.

Measuring the size of the women's calf muscles with MRI, the team found that the calf muscles of the high heel wearers were the same size as those of the women who preferred flat shoes; they hadn't shrunk. 'We were expecting slightly smaller muscle volumes in the high heel wearers because we thought that if

the muscle is in a shortened position then you are loading it less and the muscle volume should be smaller,' explains Narici.

Next Csapo and Seynnes used ultrasound to measure the muscle fibre length in the women's calf muscles, and this time they did see a difference. The high heel wearers' muscle fibres were 13% shorter than those of the women who wore flat shoes. 'This confirmed the hypothesis,' says Narici, 'because when you place the muscle in a shorter position, the fibres become shorter.' However, by shortening the fibres, the muscles would have to contract more to shorten by the same length, and if this was the case the high heel fans' calf muscles could no longer function optimally and thus would produce less force than the flat shoe wearer's calf muscles. Had the shortened muscle fibres made it more difficult for high heel addicts to walk efficiently?

The team turned their attention to the tendons that attach the calf muscle to the heel. Scanning with MRI, the team could see that the Achilles' tendon was the same length in the two groups of women. The tendon had not lengthened to compensate for the shorter calf muscle. However, the high heel fans' tendons were much thicker and stiffer than the flat shoe wearers'. Narici and his team realised that by thickening and stiffening, the Achilles' tendon compensates for the shortened muscle fibres in the calf muscle, allowing the fashion addicts' calf muscles to function optimally as they walk, but causing discomfort when walking on flat feet because the tendon cannot stretch sufficiently.

So should women give up wearing high heels? Narici doesn't think so, but suggests that fashion addicts may want to try stretching exercises to avoid soreness when they kick off their heels at the end of the day.

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