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Reply (Letter to the Editor): "Gait variability is altered in patients with peripheral arterial disease"

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Reply to Regarding “Gait variability is altered in patients with peripheral arterial disease” (Letter to the Editor)

The points raised by Crowther et al, deserve a closer evaluation. Both our group and Crowther et al studied symptomatic peripheral arterial disease (PAD) patients. However, significant methodologic differences exist between the publications. Specifically, it is established in the gait literature that 30 strides are required for an accurate measurement of gait variability and that determination of both amount (ie, standard deviations) and structure (ie, largest Lyapunov Exponent) of gait variability are necessary for its complete and optimal description as per our protocol.1,2 In contrast, Crowther et al assessed variability on the basis of three, one-stride trials and were able to calculate only the amount of variability.

Our assertion that an increase in the amount and structure of variability is an indicator of increased instability and a potential risk factor for falls is not a novel one. In fact, this conclusion has been reached by our lab and several others after years of work on gait variability in elderly and other populations with gait impairments.3 Dr. Crowther’s suggestion that increased variability may be “a gait response to the pending onset of claudication pain” incorrectly characterizes the methodology used in our article and contradicts what has been shown in the literature. In our study,1 gait variability was measured in a pain-free state (no pain or fatigue). More importantly, our work evaluating lower limb function using advanced biomechanical analysis demonstrates that the gait impairment of PAD patients is present from the initial steps they take when no pain or anticipation of pain could be present,1,4 This is consistent with previous work from our lab and others demonstrating a myopathy and neuropathy in the limbs of PAD patients.5 Finally, even if patients were able to anticipate the onset of claudication, it is unlikely that they would employ changes that increase variability as it has been previously shown that when subjects anticipate a stimulus, their locomotor system becomes more rigid and has a decreased amount of variability,6 which is the opposite of what we have found in PAD patients. We agree with the dynamical systems perspective of variability, which states that movement variability allows individuals to adapt to perturbations in the environment. The beneficial effect of variability, however, is limited. An increase or decrease past an optimal range of variation has a detrimental effect on movement,7 and this point is clearly discussed in the dynamical systems article cited to support the authors’ point.

As discussed in our article,1 a healthy locomotor system possesses a specific amount of variability having form and a complex deterministic structure.7 Deviations from this optimal level are detrimental and clinically significant, and the goal of clinical treatment should be to restore an optimal amount and form of variability.7 Our data is in line with Dr Crowther’s group and demonstrate that symptomatic PAD patients have increased gait variability at baseline ambulation in the absence of claudication pain

indicating decline of the overall health of the PAD locomotor system. This deterioration results in increased noise and instability of gait and is a potential contributing factor to the falls and mobility problems experienced by symptomatic PAD patients.

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