Relationship Between Push-off Work and Stride-to-Stride Fluctuations in Transtibial Prosthesis Users

Chase G. Rock[1], Shane R. Wurdeman[1,2], Nicholas Stergiou[1,3], Kota Z. Takahashi[1],
1. Department of Biomechanics, University of Nebraska at Omaha, Omaha, NE, 68182
2. Hanger Clinic, Houston Medical Center, Houston, TX, 77025
3. College of Public Health, University of Nebraska Medical Center, Omaha, NE, 68198

INTRODUCTION

-Healthy human gait has inherent variability with fluctuations in each step occurring over many strides [1].

-Transtibial prosthesis users experience a change in these stride-to-stride fluctuations [2].

-Changes in propulsive force during late stance produce increases in the stride-to-stride fluctuations of dynamic walking models [3].

-Prosthesis users exhibit a reduction in push-off work [4], which may contribute to changes in stride-to-stride fluctuations.

The purpose of this study is to determine the relationship between push-off work and stride-to-stride fluctuations in transtibial prosthesis users.

We hypothesized that:

1) Push-off work will be higher in 'high activity' prostheses when compared to 'low activity' prostheses.

2) Stride-to-stride fluctuations will be lower when using 'high activity' prostheses compared to 'low activity' prostheses

3) Differences in push-off work between prostheses will be correlated with differences in stride-to-stride fluctuations.

METHOD (N = 22)

Age (yrs)	Years Since Amputation	Height (m)	Mass (kg)
53 ± 11.8	7.5 ± 6.0	1.77 ± 8.3	101.5 ± 18.9

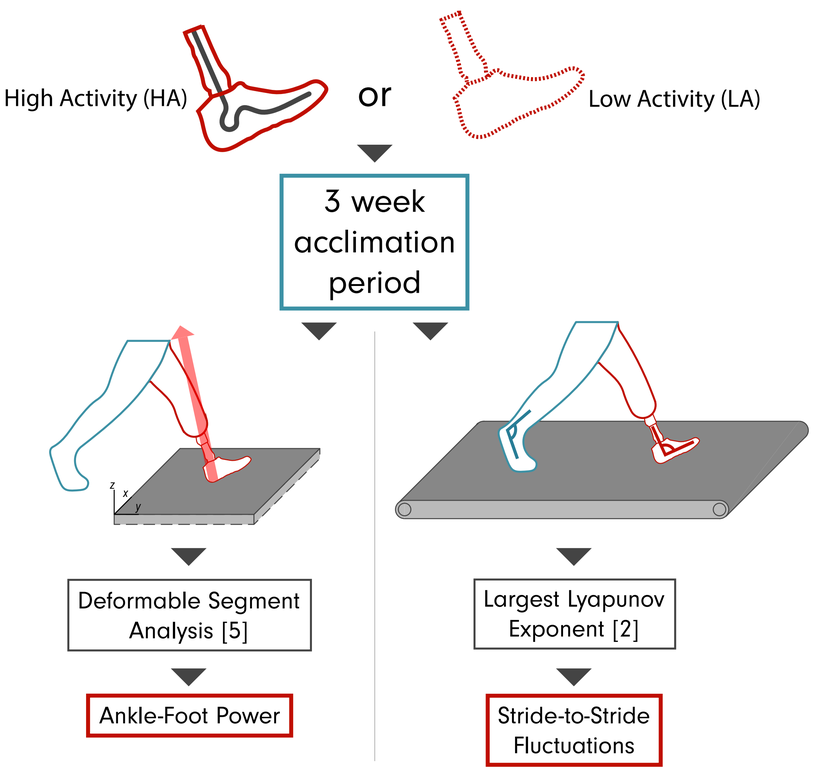

Figure 1. 22 participants with unilateral below-knee amputation were given either a high or low activity prosthesis (relative to the person's prescribed K-level) to wear during their everyday activities. After 3 weeks, gait analysis was performed. This process was completed on a high and low activity prosthesis for each participant.

RESULTS

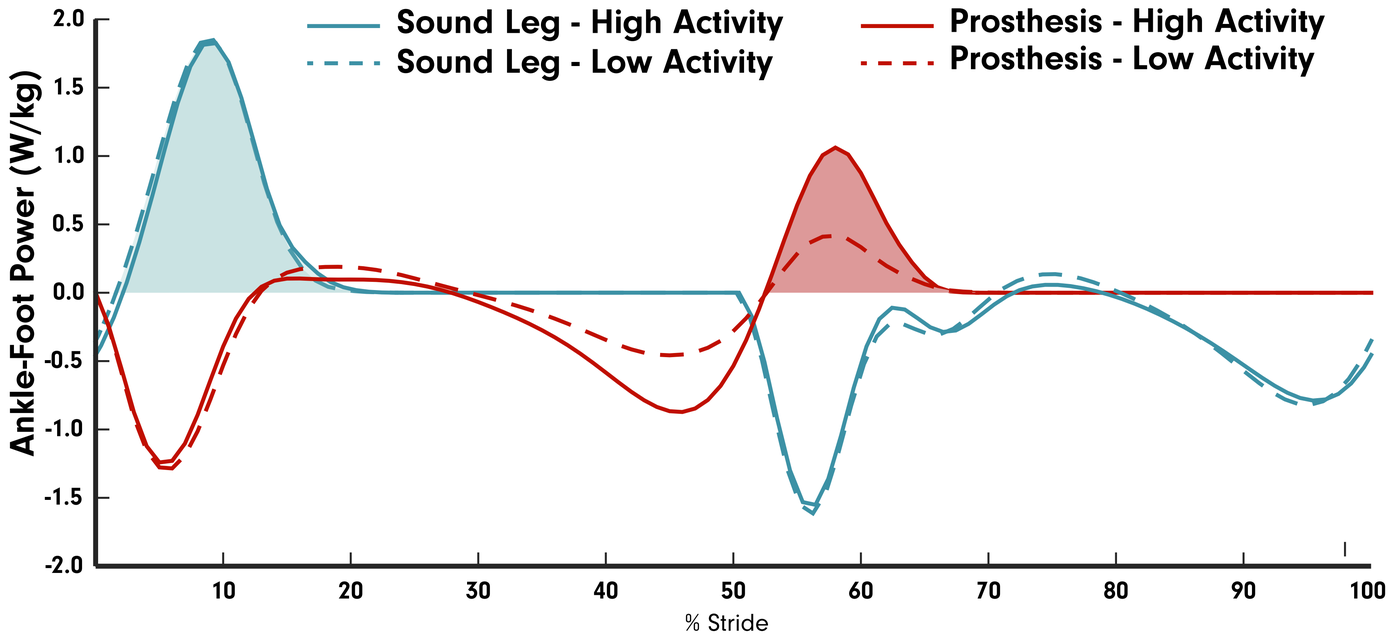

Figure 2. Ensemble power curves for the intact ankle-foot (blue) and the prosthesis (red). Shaded areas indicate late-stance push-off work.

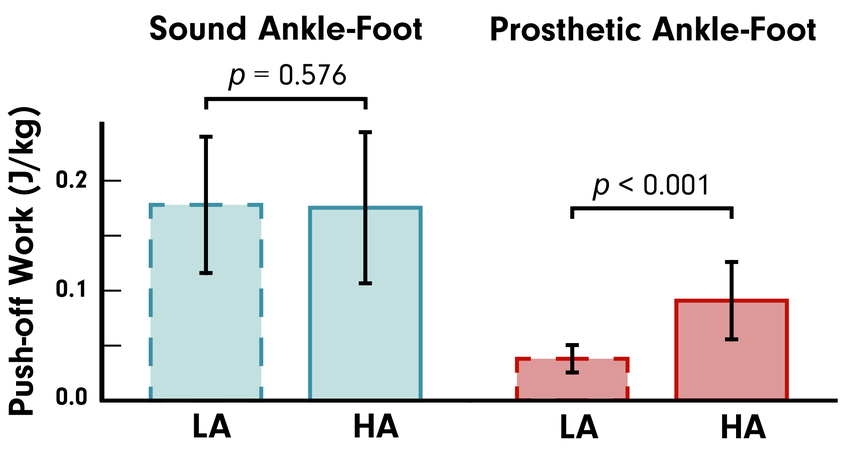

Figure 3. Push-off work from the prosthesis (i.e. energy returned during late-stance) was 140% higher in the high activity prostheses. Push-off work from the sound limb was not different between prostheses.

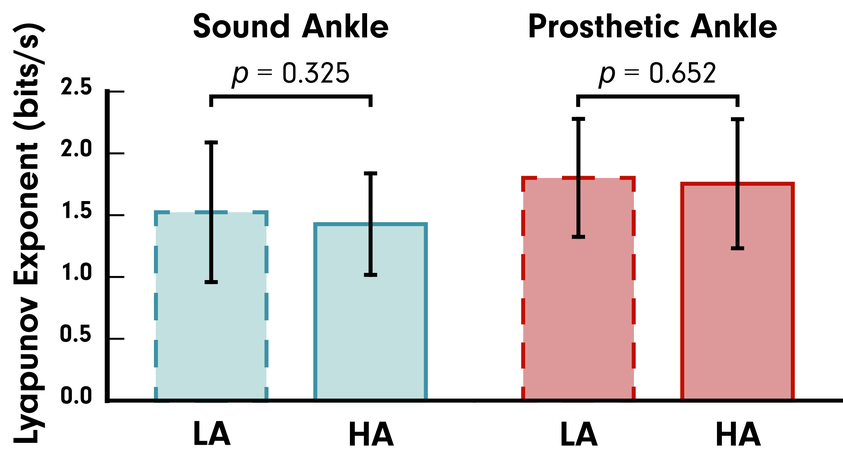

Figure 4. Stride-to-stride fluctuations during walking with the high activity compared to the low activity prostheses were not different at the sound or prosthetic ankle.

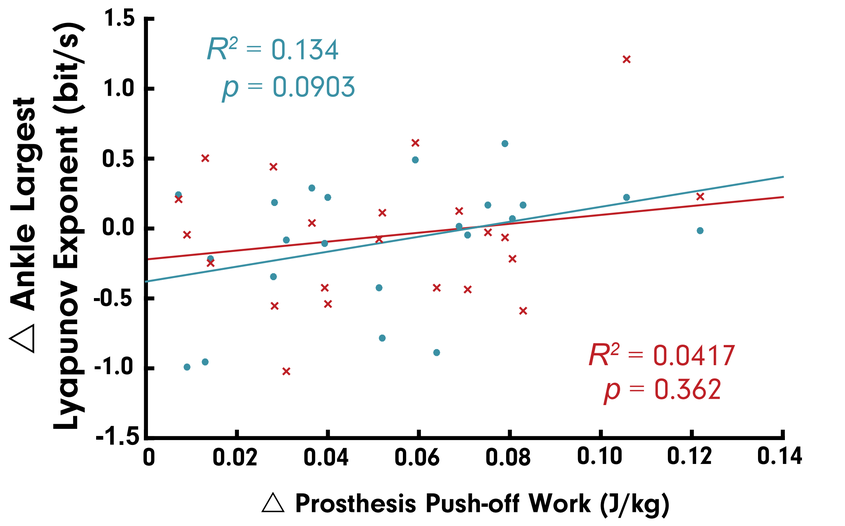

Figure 5. Differences in push-off work between prostheses were not correlated to differences in stride-to-stride fluctuations at the sound (blue) or prosthetic (red) ankle. (△ = HA - LA)

DISCUSSION

- While higher activity prostheses returned more energy during late stance, this was not accompanied by a change in push-off work from the sound limb (Fig. 2 & Fig. 3).

- There may not be a difference in the stride-to-stride fluctuations between high and low activity prostheses (Fig.4).

-Changes in push-off work are not strongly related with changes in stride-to-stride fluctuations (Fig. 5).

-The relatively small differences in energy return between prostheses (~ 0.05 J/kg; Fig. 3) may not have been substantial enough to affect the stride-to-stride fluctuations.

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