

FOOT LOADING DURING DIFFERENT WALKING SPEEDS: IS THERE A BALANCE BETWEEN PEAK PRESSURES AND PRESSURE-TIME INTEGRALS?

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INTRODUCTION

Elevated foot loading is especially considered to be a tread for patients with diabetes. In literature, most attention has been focussed on peak pressures (PP) [1,2,4]. However, in recent years the number of articles regarding foot loading in terms of pressure-time integrals (PTI) is increasing. In general, it can be stated that peak pressures will increase and pressure-time integral decrease when walking faster.

The aim of this study is determine the relationship between both foot loading variables and walking speed in more detail for healthy people, which can then be used as a reference for studies on diabetic patients.

METHODS

48 healthy subjects (21 ± 3 yrs, BMI 23 ± 3 , 16 males, 32 females) were asked to walk with 5 different speeds on a walkway in which an Emed-X pressure measuring platform (100 Hz, 4 sensors per cm^2) was mounted. After determining the comfortable speed, each test subject walked at two slower paces (-0.3m/s and -0.6m/s) and at two faster paces (+0.3m/s and +0.6m/s) with respect to the prior determined comfortable walking speed. The walking speed was electronically measured using infra-red portal detection system.

In each speed condition, plantar pressures of the right foot were measured 5 times and averaged.

Using Novel software a 10-mask division was applied, and for each mask the PP and PTI were determined. As a first order approach, the values of both variables were analysed for the heel and forefoot. A paired t-test two tailed ($\alpha=0.05$) was performed to determine significant differences.

RESULTS AND DISCUSSION

The mean comfortable walking speed was $1,22 (\pm 0.14)$ m/s. The measured PP during the comfortable walking speed resembles those found by Bryant [1]. From fast (+0.6 m/s) to slow (-0.6 m/s) walking pace the PP decreased gradually while the PTI increased more rapidly when walking slower than the comfortable walking speed (see Fig. 1). Taking into account that elevated PTI is a risk factor for ulceration and diabetic patients walk at slower pace regularly, this finding may indicate not only that fast walking will increase the risk for ulceration(due to higher PP) but slow walking as well[3]. In both PP and PTI terms the forefoot region is more loaded than the heel region. The calculated ratios of PP as well as of PTI between forefoot and heel ranged between 1.0 and 1.3. Based on their results Caselli et al[2] suggested that a ratio 2.0 might increase the danger developing ulceration, which is in line with our results for young healthy test subjects.

CONCLUSIONS

During the comfortable walking speed situation the balance between PP and PTI seems to be optimized. Walking faster results in increased PP and walking slower in increased PTI.

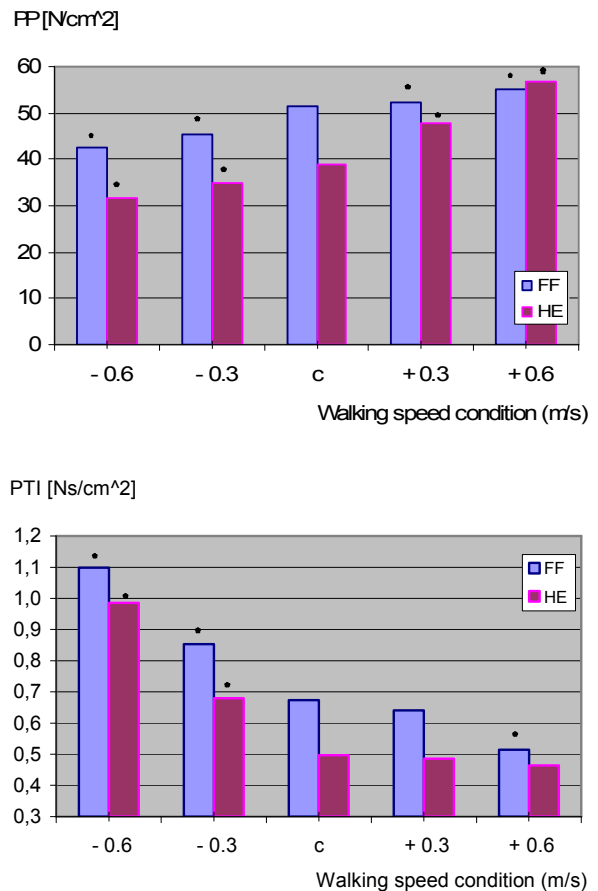


Figure 1: Mean values of peak pressures in N/cm^2 (top) and pressure-time integrals in Ns/cm^2 (below) as a function of walking speed: -0.6 m/s= slow, -10%/m/s= moderate slow, c= comfortable, +0.3m/s= moderate fast, +0.6m/s= fast. *=significant difference ($\alpha=0.05$) with respect to value of comfortable speed.

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