ASSOCIATION BETWEEN PEAK FOREFOOT PLANTAR SHEAR STRESSES AND PHYSICAL BODY MEASURES

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INTRODUCTION

Preliminary studies have shown that plantar shear stresses are increased in diabetic patients with neuropathy. It is also known that diabetic patients tend to be overweight. Peak pressure has been long considered a risk factor for diabetic foot ulceration. Earlier studies on the relationship between body mass and/or weight and peak plantar pressures in diabetic patients revealed a relatively weak association [1,2]. Cavanagh et al (1991) demonstrated a significant correlation between body mass and peak pressures in diabetic patients. Ahroni et al (1987) on the other hand, claimed that peak pressure values of heavier individuals may not necessarily be abnormally high. Another physical body attribute, body height, has been associated with step length [3]. It is also known that step length depends on anteroposterior ground reaction forces [4].

To our knowledge the literature does not contain any reports that discuss a potential correlation between peak plantar shear stress and body measures such as body mass or height. The purpose of this study was to explore these relationships using a custom-built pressure-shear plate.

METHODS

The study was approved by the Institutional Review Board. Subjects gave informed consent before participation. Group DN consisted of 14 diabetic neuropathic patients (2 F, 64.8±6.8 years, 32.0±5.1 BMI). The second group (DC) comprised 14 diabetic patients (9 F, 52.4±12.9 years, 28.9±7.4 BMI) without neuropathy. The third group was the healthy control (HC) group, which included 11 individuals (7 F, 65.5±6.0 years, 27.8±5.9 BMI). Peripheral neuropathy was tested by a Biothesiometer and 5.07 Semmes-Weinstein monofilaments. Each subject walked multiple times at self-selected speeds on the stress plate, which was installed on a 12-ft walkway and set flush. Data

Figure 1: PS-Body Mass (top) and PS-Body Height (bottom) correlation graphs.
RESULTS AND DISCUSSION

No correlation was statistically significant. No absolute value of r was over 0.5. Neither body mass nor body height could account for any degree of variance in peak shear or peak shear-time integral values. Results indicated that plantar shear under the foot, regardless of a diabetic condition, do not depend on body mass or height. Table 1 displays the calculated r and respective p values. Figure 1 displays the correlation graphs for PS. Previous studies indicated that although there may be a statistically significant correlation between body mass and peak plantar pressures, this relationship is somewhat weak. The reason to the lack of a strong relationship might be variations in the structure of the foot. For example, in diabetic patients with peripheral neuropathy, compromised plantar fat may lead to bony prominent areas, where high pressure values can be seen. This may also be true for localization of plantar shear. Also, the proportional dimensions of the human body and foot may present great variation, which would also lead to substantial variations in the plantar surface area.

This study revealed that, PS and STI may vary regardless of body mass. These results also confirm an earlier report that showed that plantar shear stresses cannot be easily predicted based on plantar normal loads [5].

It was also found in this study that PS and STI may vary independent of body height. This might also indicate that PS and STI do not necessarily depend on gait speed; however this hypothesis needs to be further investigated.

It is thought that effective load bearing area, gait speed, muscle activity, frictional properties and moisture content of the skin, and other intrinsic factors might influence local shear stresses as well as body mass and height. Such a complicated relationship needs to be further investigated in a large sample study. The purpose of this study was to present preliminary data on the potential association of plantar shear stress and physical body measures.

REFERENCES


ACKNOWLEDGEMENTS

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<tr>
<td></td>
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Table 1: Pearson Correlation Coefficients (p values) of Group DN, DC and HC correlations.