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Short communication

Reliability of plantar pressure platforms

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ABSTRACT

Plantar pressure measurement is common practice in many research and clinical protocols. While the accuracy of some plantar pressure measuring devices and methods for ensuring consistency in data collection on plantar pressure measuring devices have been reported, the reliability of different devices when testing the same individuals is not known. This study calculated intra-mat, intra-manufacturer, and inter-manufacturer reliability of plantar pressure parameters as well as the number of plantar pressure trials needed to reach a stable estimate of the mean for an individual. Twenty-two healthy adults completed ten walking trials across each of two Novel emed-x® and two Tekscan MatScan® plantar pressure measuring devices in a single visit. Intraclass correlation (ICC) was used to describe the agreement between values measured by different devices. All intra-platform reliability correlations were greater than 0.70. All inter-emed-x® reliability correlations were greater than 0.70. Inter-MatScan® reliability correlations were greater than 0.70 in 31 and 52 of 56 parameters when looking at a 10-trial average and a 5-trial average, respectively. Inter-manufacturer reliability including all four devices was greater than 0.70 for 52 and 56 of 56 parameters when looking at a 10-trial average and a 5-trial average, respectively. All parameters reached a value within 90% of an unbiased estimate of the mean within five trials. Overall, reliability results are encouraging for investigators and clinicians who may have plantar pressure data sets that include data collected on different devices.

1. Introduction

Plantar pressure measurements are part of many clinical and research protocols. Several companies manufacture plantar pressure platforms, and accuracy and reliability of individual makes of platforms have been demonstrated [1–3]. However, reliability (i.e. reproducibility of an individual's plantar pressure parameters) *between* platforms of different manufacturers or platforms of the same manufacturer has not been established. Platform technology is manufacturer-specific which results in different resolutions, sensor types, sampling rates, and ranges of detectable pressure [4]. These differences may cause plantar pressure measurements of an individual to vary from one manufacturer's platform to another's. Researchers and clinicians may wish to compare data collected on platforms of different manufacturers due to changes in available equipment over time or to combine data sets from separate studies or clinics. Therefore, the primary purpose of this study is to determine the reliability between and within Novel emed-x® and Tekscan MatScan® plantar pressure platforms.

Additionally, the minimum number of trials required for an unbiased estimate of the mean for plantar pressures is not established. A previous study reported coefficients of reliability for whole-foot plantar pressure measurements based on the number of trials collected [2]. As a secondary purpose, this study will report parameter stability for ten regions of the foot for the emed-x® and MatScan® to determine an appropriate number of data collection trials.

2. Methods

All methods were approved by the IRB and subjects completed informed consent forms.

2.1. Subjects

Twenty-two participants were recruited. Participants were healthy adults aged 28.6 ± 9.9 years (range: 20–53), height

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1.7 ± 0.1 m, and mass 75.5 ± 13.4 kg. Thirteen participants were male. No participants had a history of gait abnormality. Resting calcaneal stance position was recorded for each subject to describe foot alignment. On average, subjects were in 6.2 ± 5.5° of calcaneal valgus, indicating normal foot alignment [5].

2.2. Platforms

Plantar pressure measures were recorded on four platforms, two emed-x® plates (Novel, Munich, Germany) and two MatScans® (Tekscan, Boston, MA). The emed-x® consists of 6080 capacitance-based force transducers at a resolution of 4 sensors/cm^2. The MatScan® consists of 2288 resistive sensors at a resolution of 1.4 sensors/cm^2.

All platforms were within one year of being calibrated to manufacturers' standards.

2.3. Procedure

Participants completed 10 satisfactory walking trials on each of the 4 platforms. Only right-foot data were collected using the two-step method to expedite data collection. The two-step method consists of the participant landing on the pressure platform on the second step. This method has been shown to be consistent with

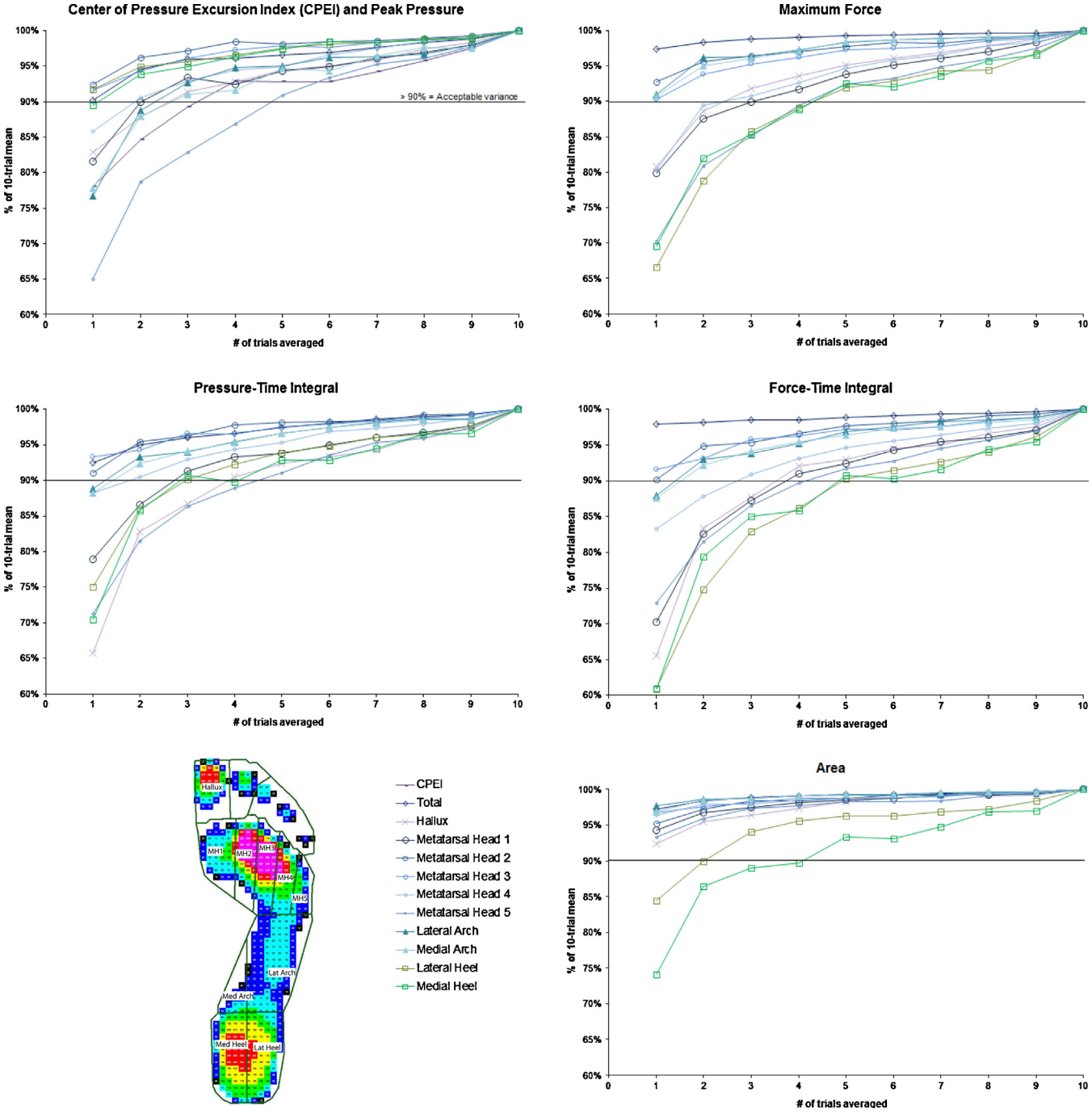

Fig. 1. Parameter stability as % of the 10-trial mean by number of trials averaged. Horizontal line at 90% indicates acceptable threshold. All parameters reached this threshold within 5 trials. Key displays regions of the foot by label and where the regions are on an example plantar pressure trial. "Total" indicates whole foot.