

# COMPARISON OF PLANTAR PRESSURE MEASUREMENTS OBTAINED DURING BAREFOOT AND SHOD CONDITIONS

Jonathan S. Akins, Karen A. Keenan, Brian P. Dugan, Melanie Francis, John P. Abt, Timothy C. Sell, Scott M. Lephart

Neuromuscular Research Laboratory, University of Pittsburgh, PA

## BACKGROUND

Pedobarographic platforms allow for assessment of plantar pressures at the foot-ground interface whereas pedobarographic insoles allow for assessment at the foot-shoe interface. It has been suggested that barefoot assessments may be more sensitive in detecting risk factors for the development of exercise related lower leg pain than shod assessments (Willems, 2007). Plantar pressures may be altered or attenuated by footwear, thereby making detection of small but significant variations in plantar pressure measurements more difficult in shod conditions. In addition, barefoot assessments require less subject preparation, may allow for data to be collected on more subjects in a shorter period of time, and require a smaller laboratory space, thereby potentially simplifying the data collection process. The purpose of this study was to compare plantar pressure measurements obtained while barefoot to those obtained while shod.

## METHODS

Ten healthy males (n=8) and females (n=2) participated in this study (age:  $27.7 \pm 4.1$  years, mass:  $77.6 \pm 10.7$  kg, height:  $174.3 \pm 7.0$  cm). Data were collected on two different days in both barefoot and shod conditions. Barefoot measurements were obtained with the EMED-X<sup>®</sup> (Novel GmbH, Munich, Germany), sampling at 100Hz. A two-step approach at a self-selected speed was utilized for all trials. After familiarization of the task, subjects performed 10 right-foot trials.

Shod measurements were obtained with the PEDAR-X<sup>®</sup> system (Novel GmbH, Munich, Germany), sampling at 100Hz. Subjects used their own athletic footwear, without socks, and were asked to practice straight-line walking at their "usual" walking speed. After familiarization, three trials of 20 consecutive straight-line steps across a level tiled floor were recorded.

For the barefoot trials, average maximum force (MF) and peak pressure (PP) were calculated for all trials. For the shod trials, the first and last two right steps were removed and MF and PP were calculated for the remaining right-foot steps. A similar mask was applied to both barefoot and shod trials with the following regions: medial heel, lateral heel, midfoot, each metatarsal (1-5), great toe, toe 2, and toes 3-5. A t-test compared MF and PP obtained in the barefoot (EMED) and shod (PEDAR) conditions ( $\alpha=0.05$ ).

## RESULTS

PEDAR and EMED measurements differed significantly in several regions (Table 1).

Region	PEDAR	EMED
	Maximum Force	
GT	110.1 ± 33.2	126.1 ± 64.7
T2	60.4 ± 18.3	29.4 ± 15.9 *
T345	75.6 ± 24.7	25.9 ± 20.0 *
MT1	145.6 ± 54.0	161.1 ± 62.8
MT2	126.6 ± 37.7	186.4 ± 33.4 *
MT3	101.9 ± 29.0	181.5 ± 36.0 *
MT4	73.7 ± 23.7	101.9 ± 37.6 *
MT5	49.8 ± 18.1	38.0 ± 22.8
Midfoot	184.6 ± 66.4	139.9 ± 87.0
Lat Hindfoot	276.0 ± 60.5	232.5 ± 48.1
Med Hindfoot	288.6 ± 67.9	282.0 ± 49.1
Peak Pressure		
GT	194.9 ± 46.8	334.4 ± 179.3 *
T2	165.6 ± 44.3	205.1 ± 103.3
T345	111.5 ± 37.3	105.3 ± 56.7
MT1	192.2 ± 41.3	266.6 ± 116.1
MT2	193.3 ± 43.1	554.4 ± 278.2 *
MT3	185.8 ± 42.8	391.9 ± 143.1 *
MT4	159.9 ± 43.7	246.4 ± 109.4 *
MT5	117.8 ± 36.2	176.9 ± 137.3
Midfoot	121.4 ± 32.3	118.2 ± 44.3
Lat Hindfoot	185.9 ± 30.9	367.3 ± 124.0 *
Med Hindfoot	192.1 ± 33.2	367.0 ± 97.8 *

\* p < 0.05

Table 1: Maximum force and peak pressure for each region (mean ± SD)

## DISCUSSION

Statistically different plantar pressure measurements were obtained in barefoot and shod conditions. Peak pressure appears to be significantly attenuated in the hindfoot, MT2 through MT4, and the great toe in the shod condition. Maximum force was significantly attenuated in MT2 through MT4, T2 and T345. If the variable of interest is peak pressure, then barefoot assessments may be preferred. However, since most athletic activities are performed while shod and the results were inconsistent, it may be more appropriate to assess plantar pressure in the shod condition.

## REFERENCES

Willems *et al*, Med Sci Sports Exerc 39:330-339, 2007.