EFFECT OF WALKING SPEED IN CHANGE OF THE PEAK PLANTAR PRESSURE DISTRIBUTION

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INTRODUCTION

The plantar pressure pattern has been used as the evaluation tools for foot disorders, the numerical values of peak pressure in heel and metatarsal areas are usually critical, however, these local maximum values are highly affected by the walking speed, measurement sensing hardware as well as software used. By using an in-shoe pressure measurement system, Kernozek found that the plantar peak force tended to increase with gait speed mainly in the heel region, and almost no changes in the forefoot regions [1]. Hsiang et al [2] used a force plate and found out the path of center of gravity changed in faster walking speed which also resulted in an adverse effect on the variability and the reliability of the gait pattern. White et al [3]also found that increasing the walking speed induced higher peak ground reaction forces in loading response of a gait cycle but the reaction forces decreased linearly in mid stance, and no profound changed in push off phase. Zhu's study showed that as walking cadence increased, pressure-time integrals and foot-to-floor contact durations decreased, and peak plantar pressures increased [4].

The objective of this study was to find out the effect of walking cadences to the plantar pressure by an innovative pressure platform-type system with higher sampling rate.

METHODS

Ten healthy young volunteers without any foot pain or disorders, five for each male and female gender with mean ages of 22 ± 3 years old and body weight of 61 ± 13 kgs were recruited. The subjects were asked to walk along a 10M pathway with barefoot in three speeds normal walking speed, and 30% higher and lower of normal one on the RS-Scan 1M Footscan high frequency platform system (Rsscan Int. Belgium). Ten successful foot-print data of each cadence were collected for further analysis in nine interesting region namely toe mask (T1) five metatarsal head masks (M1,M2,M3,M4,M5), and two heel masks (H1, H2).

RESULTS AND DISCUSSION

The average self-path normal walking speed was 98.23 $\pm$ 4.53 steps/min, 30% lower was 72.46 $\pm$ 4.22 steps/min, and 30% higher was 132.57 $\pm$ 6.37 steps/min. The maximum peak plantar pressure was 17.02 N/cm^2 (±3.39), 21.02 N/cm^2 (±3.65), and 21.79 N/cm^2 (±4.05) for lower, normal, and higher walking speed, respectively. These peak values were at the left medial heel region. The pressures were linearly increased as walking speed increased, except at the left forefoot region which showed highest at the speed of normal walking (Figure1 and 2). The contact time at each marked region was decreased as the walking speed increased. The maximum contact times of all subjects were at the right 3rd metatarsal head. The impulses were also decreased as the speed increased but the maximum values were at left 2nd metatarsal head for all subjects.

These results are similar to that of referred studies except the plantar pressure at the left forefoot regions. Inman reported that the flexion angle at the loading response reduced by 67% when walked at 60m/min and by 38% at 120 m/min in comparison with 90 m/min. This study showed similar result at the left foot during midstance to push off response. This may imply taht, the dominate leg (left foot in this study) is used to control the walking speed path which may result in changing of ground reactions

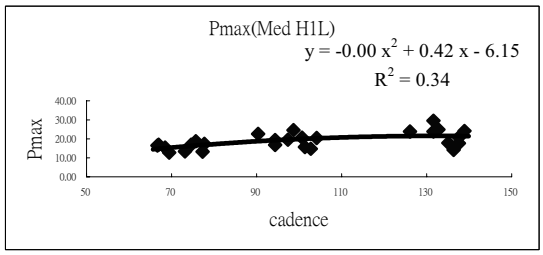

Fig. 1: The relationship of Peak pressure and cadence at left foot medial heel region

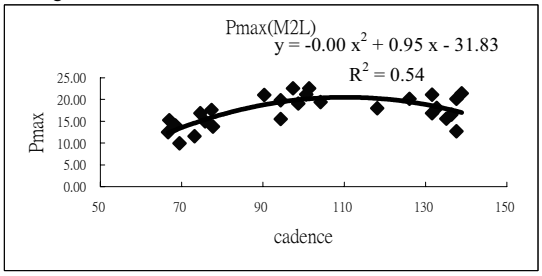

Fig. 2: The relationship of Peak pressure and cadence at left foot second metatarsal head

CONCLUSIONS

The results showed that with second order linear regression the peak plantar pressure was basically increased as the walking speed increased except the left forefoot region which had its highest value at the normal speed. The contact time and impulse were decreased as the speed increased.

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