APPLICATION OF PLANTER FORCE MEASUREMENT IN EVALUATION OF SOCCER SHOES

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INTRODUCTION: Normal soccer shoes are manufactured using homogenous material for midsole. Soccer game requires the players to tackle the soccer ball as quickly as possible. It was thought that a dual density material design of the midsole may provide better control to the foot. To study this question, we developed prototype soccer shoes with two different midsole designs. One was made up by homogeneous EVA material (Shore A 95) and the other (S2) was made up by the same material except for the forefoot area where a relatively soft EVA material (Shore A 85) was used. Both shoes have similar structure and material in all other aspects including the studs. The purpose of this study was to compare the plantar force generated during 30-m sprint wearing soccer shoes with homogeneous and dual density midsole designs.

METHODS: Fifteen male soccer players (8.1±1.6 yr; 68.03±4.62 kg; 177.1±5.3 cm) participated in this study. The specific soccer training history of the subjects was 7.79±2.73 yr. All subjects were free of lower extremity injury or pain. The subject gave their informed, written consent in accordance with local Conjoint Clinical Research Ethics Committee policy on using human subjects.

The study was conducted on an artificial turf soccer game field. An in-shoe force measurement system (Novel Pedar System, Germany) was employed to measure the ground reaction forces exerted on the force sensors of the insole. Each insole contains 99 force sensors. Before the trial, all sensors of the insole were individually calibrated with the trublu calibration device (Novel Pedar System, Germany). The insoles were then inserted into the shoes of each subject. The data collection box of the system was attached to a waistband of the subject. During the trial, subjects were asked to run the 30-m straight track on the artificial turf 5 times in each shoe condition. The force signals of sensors were recorded at 50Hz and transmitted and saved in a data memory card (PCMCIA). In each run, force signals of the dominant foot in middle 5 strides of the 30m distance were selected for post-event analysis.

The Multimask software of Novel Pedar System was used to determine the nine anatomical regions of the foot on the insole (M1-M9). The masks are M1 for medial heel, M2 for lateral heel, M3 for medial mid foot, M4 for lateral mid foot, M5 for first metatarsal head, M6 for second metatarsal head, M7 for the three lateral metatarsal heads, M8 for the great toe, and M9 for the other toes. The force exerted on each mask was calculated and normalized to the body weight (%BW). The parameters were averaged across the five strides for each subject and then averaged across all subjects for each shoe condition. Pared t-test was used to compare the peak force and the time of the peak force for each foot mask between the two shoe conditions. SPSS for Windows software was used and the significance level was set at 0.05.

RESULTS: Table 1 shows the peak force exerted on the total foot and each foot mask. Running with S2 showed significant greater peak force on the masks of M1, M5, M6 and M9 than with S1. Our data supported our previous subjects' perceived rating on plantar comfort where they felt higher plantar force and therefore more stain on the toes and the 1st and 2nd metatarsal heads when wearing S2 than with S1.

Table 1 The peak force magnitudes (%BW)

Shoe	Total	M1*	M2	M3	M4	M5*	M6*	M7	M8	M9*
S1	336.4	24.7	35.0	9.4	34.9	60.2	65.6	58.0	33.1	39.9
S2	345.5	38.4	46.8	12.7	37.1	70.1	75.2	61.1	36.0	45.1

* indicates significant difference between the two

DISCUSSION: Running with S2 resulted in greater peak force exerted on the medial heel, first metatarsal head, M6 for second metatarsal head, and lateral toes, which may be attributed to the dual density structure of the midsole. The over flexible midsole provided less support to the foot and the sequence of peak force transition from heel to toes was disrupted.

CONCLUSION: The dual density midsole design affects the amplitude of plantar force. Caution should be made when the attempt is made to design dual density midsole soccer shoes.

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