

# COMPARISON OF PLANTAR FORCE OF SOCCER SHOES BETWEEN TWO MID SOLE DESIGNS

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## INTRODUCTION

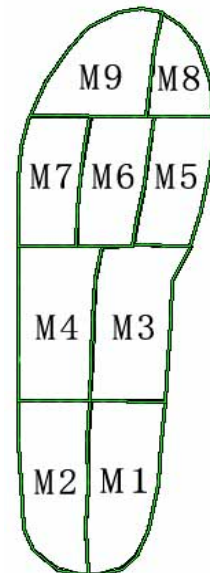
The normal soccer shoes are manufactured using homogenous material for mid sole. Soccer game requires the players to react to the ball as quickly as possible. It was thought that a dual density material design of the mid sole in which a soft material is used for the area to support mid foot and bases of metatarsals may provide better flexibility to the foot. However, the effects on the plantar force of such design have not been reported. The purpose of this study was to compare the plantar force produced during 30-meter (m) sprint when wearing soccer shoes with homogeneous and non-homogenous mid sole material design.

## METHODS

Two types of soccer shoes were used in this study. One design (S1) was using homogeneous material to make up the mid sole; the other (S2) was using the same material to make up the mid sole except for the area of mid foot where a relatively soft material was used. The two designs show the similar structure and material including the location of studs.

Fifteen 15 professional soccer players (age  $18.1 \pm 1.6$  years, body weight  $68.03 \pm 4.62$  kg, body height  $177.1 \pm 5.3$  cm) participate in this study. An in-shoe force measurement system (Novel Pedar System, Germany) was employed in this study to measure the ground reaction forces exerted on the force sensors of the insole. Each insole contained 99 force sensors. With the aid of the trublu calibration device (Novel Pedar System, Germany), all sensors of the insole were individually calibrated before the testing. The insoles were placed inside both of each subject's shoes. The data collection box was attached to a waistband of the subject. During the testing, subjects were asked to run the 30-m straight track on the artificial turf for 5 times for each shoe condition. The force signals of sensors were recorded at 50Hz and saved in a PCMCIA card that was installed in the collection box of the system. Five running cycles force signals of the left foot during the middle of the 30m distance were used for post-event analysis.

The multimask software of the system was used to determine the nine anatomical regions, or masks (M1-M9), on the plantar surface of the foot (Figure 1). 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 other three metatarsal heads, M8 for great toe, and M9 for the other toes. The timing and force exerted on each mask were calculated. The peak force was normalized to the body weight (%BW). The time of peak force occurrence to each mask were normalized to contact time (%Contact time). All subject's data were averaged and the pared t-test was used to compare the peak force on the same mask between the two shod conditions. SPSS for Windows was used and the significance level was set at 0.05.



**Figure 1** The foot sole masks

## RESULTS

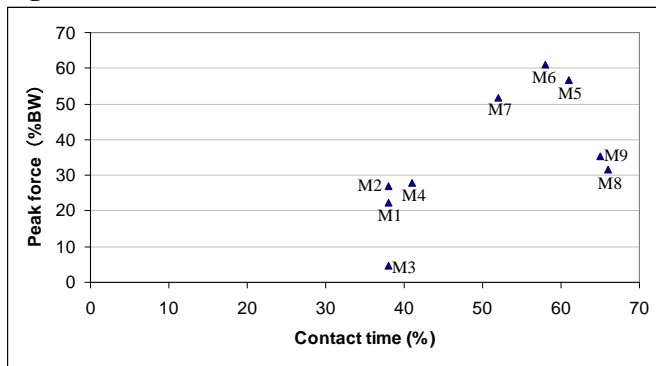
Table 1 showed the peak force exerted on the total foot and each foot mask. Running with S2 showed significant greater peak force at the masks of M1, M5, M6 and M9 than S1. Figure 2 and Figure 3 showed the peak force occurrence of each mask during contact time with S1 and S2 respectively. The transfer of peak force along the masks showed different patterns between the two types of shoes.

**Table 1** The peak force magnitudes (%BW)

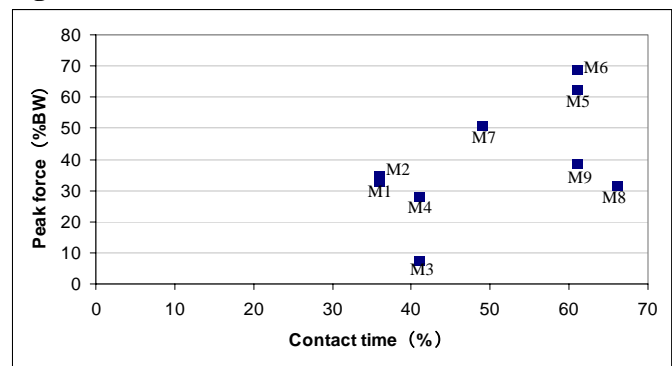
	Total	M1*	M2	M3	M4	M5*	M6*	M7	M8	M9*
S1	336.4	24.7	35.0	9.4	34.9	60.2	65.6	58.0	33.1	39.9
S2	345.5	38.4	46.8	12.7	37.1	70.1	75.2	61.1	36.0	45.1

\* indicates significant difference between the two

**Figure 2** Peak force occurrence to each mask in S1



**Figure 3** Peak force occurrence to each mask in S2



## DISCUSSION

In a parallel conducted questionnaire study, the subjects rated similarly in overall comfort, traction, weight and the other characteristics between S1 and S2. However, they felt higher plantar force and therefore stain on the toes and the heads of the 1<sup>st</sup> and second metatarsals. The present data supported subjects' perceived rating on plantar force. The data in Table 1 indicated that the soft mid sole design in S2 did not facilitate the sharing of the peak force of one mask by other masks. The occurrence of peak force in M7 was earlier with S2 than with S1. Moreover, the transition of peak force from heel to toes showed different pattern between the two types of shoes. The time needed for transition of peak force from M4 to M7 was shorter with S2 than S1. In S2, the peak force to M5, M6 and M7 were recorded at the same time, while the occurrence of peak force to M5 and M9 in S1 was delayed (Figure 1 and Figure 2). In summary, the use of softer material to make up the area of the mid foot showed greater peak force and earlier occurrence of peak force in toes and heads of metatarsals. The sequence of peak force transition from heel to toes was disrupted.

## REFERENCE

Eils E, Streyl M, Linnenbecker S, Thorwesten L, Volker K, Rosenbaum D (2004) Characteristic plantar pressure distribution patterns during soccer-specific movements, *American Journal of Sports Medicine*, 32(1): 140-145