

# Comparison of In-shoe Plantar Pressure Between Korean Combat Boots and Running Shoes: A Prospective Comparative Study

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**INTRODUCTION:** Combat boots are special shoes designed for soldiers to wear during activities in rough terrains, such as long marches or military training. Combat boots have been associated with a high incidence of musculoskeletal injuries, such as stress fractures and tendinitis, and some studies have reported that combat boots increase the injury rate of the lower extremities. In the past, combat boots, unlike running shoes, were designed to ensure durability rather than functionality and fitness, but recently, attempts have been made to develop combat boots with excellent functionality. While it is important that these newly developed combat boots are comparable to running shoes in terms of functionality, no studies have yet analyzed in-shoe plantar pressure. Therefore, this study aimed to compare the difference of in-shoe plantar pressure between Korean combat boots and running shoes. We hypothesized that the newest Korean combat boots would have comparable plantar pressure distribution to running shoes.

**METHODS:** Prior to performing the study, the study protocol was approved by our Institutional Review Board (IRB). Written informed consent was obtained from the participants. We prospectively recruited 30 asymptomatic male participants, who are considered as candidates for military services, from the local area. Two types of shoes, newly developed Korean combat boots and running shoes, were examined (Fig. 1). After subjects were fitted with the two types of shoes, they walked at 85 bpm, which was guided by the metronome and walking was performed on a 7.5-m walkway for eight times. Data of pedobarographic measurements were collected using the pedar®-X in-shoe pressure measurement system. Peak pressure (PP), pressure time integral (PTI), contact area, and contact time were analyzed. A paired t test and Wilcoxon signed rank test were performed to evaluate the differences in the pedobarographic data between two types of shoes.

**RESULTS SECTION:** Significant differences in PP were observed between two types of shoes in all regions except the medial FF (Fig. 2). The PP of the combat boots was significantly higher than those of the running shoes at the region of central forefoot (FF) ( $p=0.007$ ) and lateral FF ( $p<0.001$ ). The PTI of the combat boots was significantly higher than those of the running shoes at the region of central FF ( $p<0.001$ ) and lateral FF ( $p<0.001$ ). Significant differences in contact area were observed between the two types of shoes except for the region of lateral FF and medial heel. The contact area of the combat boots was significantly lower than those of running shoes at the region of hallux ( $p<0.001$ ), 2-5 toes ( $p<0.001$ ), medial FF ( $p<0.001$ ), central FF ( $p=0.018$ ), and midfoot ( $p<0.001$ ). The contact time of combat boots was significantly higher than those of running shoes at the region of central FF ( $p=0.040$ ) and medial heel ( $p<0.001$ ).

**DISCUSSION:** The present results showed that combat boots resulted significantly higher PP and PTI in the central and lateral FF than running shoes. The metatarsal bone, corresponding to the central and lateral FF, is considered as the most common region for stress fracture among military recruits. The contact area of combat boots was significantly lower than that of running shoes in the hallux, 2-5 toes, medial FF, central FF, and midfoot. Contact area is an important factor influencing the redistribution of plantar pressure. According to our study, Korean combat boots should be developed to increase contact area and distribute impulse under the head of metatarsal bone.

**SIGNIFICANCE/CLINICAL RELEVANCE:** Understanding plantar pressure distribution of combat boots can be helpful in the development of combat boots and prevention of injury.

Fig. 1. Two types of shoes. (A) running shoes and (B) new Korean combat boots.



Fig. 2. Comparison of (A) peak pressure (PP, kPa) and (B) pressure time integral (PTI, kPa × sec) between two types of shoes. Asterisks indicate significant differences between shoes.

