

Comparison of In-shoe Pedobarographic Variables Between Two Orthoses During Toe and Heel Gait

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INTRODUCTION: Foot and ankle orthoses play a significant role in the conservative treatment of foot and ankle injuries and postoperative rehabilitation after foot and ankle surgery. Different types of orthoses can affect plantar pressure distribution during certain gait patterns. Toe and heel gait are common patterns of gait assigned for optimal recovery in patients with foot or ankle injuries. However, few studies have investigated the measurement of plantar pressure during such selective gait, and most of them focused on certain ill gait patterns or specific patient conditions rather than intentional gait comparison. Therefore, this study aimed to evaluate differences in plantar pressure between postoperative shoes and walker boots during toe and heel gait in healthy individuals.

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. A total of 30 healthy individuals with a mean age of 21.7 ± 1.2 years were included. Two types of orthoses, the postoperative shoe and walker boot also known as Rebound® air walker, were used in this study. Two types of gaits, toe and heel, were performed while wearing each orthosis on the right side of the foot. A standardized running shoe was worn on the left side of the foot. The participants were asked to walk a 7.5m walkway at a comfortable, cadence-controlled pace of 85 steps/min while listening to the beat of the metronome. Five trials were performed; the first and last trials were excluded from the analysis. In addition, the middle 15 steps of each trial were analyzed to ensure data validity. Plantar pressure variables including contact area, peak pressure, and maximum force were collected using the pedar®-X in-shoe pressure measuring system. We used a mask consisting of the first toe, second to fifth toes, first (medial) metatarsal head, second to fifth (lateral) metatarsal heads, medial midfoot, lateral midfoot, medial hindfoot, and lateral hindfoot. A paired t-test was used to compare plantar pressure variables between the two orthoses.

RESULTS SECTION: During toe gait, while both orthoses demonstrated a similar contact area, peak pressure, and maximum force in the hindfoot areas, walker boots were superior in reducing the peak pressure and contact area in the forefoot area (Fig. 1). During the heel gait, both orthoses demonstrated similar contact areas, peak pressures, and maximum forces in the toe area. However, while postoperative shoes showed an increased contact area and maximum force in the metatarsal head area, walker boots were superior in reducing peak pressure in the lateral hindfoot (Fig. 2).

DISCUSSION: The differences in the contact area, peak pressure, and maximum force pattern between the two orthoses may be attributed to the characteristics of each orthosis. Although the outer part of the walker boot is solid and durable, the characteristics of the rocker bottom help promote the redistribution of the load from the forefoot to the midfoot. Therefore, the authors suggest that walker boots with toe gait are recommended for patients who need to reduce plantar pressure in the forefoot as well as hindfoot. The authors are also educating patients to wear walker boots and weight bear with toes and crutches during postoperative rehabilitation when hindfoot surgery is performed. On the other hand, a postoperative shoe has a solid outer sole that limits bending of the plantar surface. In addition, because ankle motion is freely available, we assumed that the weight was loaded along the lateral hindfoot, lateral midfoot, and lateral metatarsal head during heel gait. Therefore, the authors recommend walker boots with heel gait for patients who need to reduce plantar pressure in the hindfoot as well as forefoot. Generally, this includes patients who undergo bunion surgery, Akin's procedure, metatarsal foot surgery, or operation of Morton's neuroma surgery in the forefoot. However, since walker boots sacrifice ankle joint motion, they can be used to reduce forefoot pressures in the early postoperative stages of forefoot surgery, but later, to recover ankle joint movement, they can be replaced with postoperative shoes. A significantly high peak pressure in the lateral hindfoot may be compensated by the use of crutches.

SIGNIFICANCE/CLINICAL RELEVANCE: The results of our study can serve as a guideline for orthopedic physicians in selecting a specific type of orthosis for patients following foot and ankle trauma and postoperative recovery.

Fig. 1. Comparison of contact area, peak pressure, and maximum force between two orthoses during toe gait. Stars denote significant differences between groups.

Fig. 2. Comparison of contact area, peak pressure, and maximum force between two orthoses during heel gait. Stars denote significant differences between groups.

