Comparison of Plantar Pressure Distribution in Hallux Valgus and Healthy Feet

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Disclosures:

Introduction: Hallux valgus deformity is thought to affect the function of the great toe. Several authors reported plantar pressure distribution in hallux valgus1) 2) 3), but there were no detailed reports regarding the differences in the plantar pressure distribution between hallux valgus and healthy feet. The purposes of the present study were to perform a comparative investigation of plantar pressure distribution and to clarify the function of the great toe during walking in hallux valgus and healthy feet.

Methods: The subjects were 27 patients (32 feet) with symptomatic moderate-to-severe hallux valgus (the mean hallux valgus angle of 36°, the HV group) and 17 volunteers (34 feet) without history of foot injury or complaints and obvious foot deformity on inspection (the C group). All the subjects were women, and no significant differences were observed in height, weight, and body mass index between the HV and C groups, although mean age was significantly different at 55 years in the HV group and 47 years in the C group (P<0.001). In both the HV and C groups, plantar pressure during walking was measured with F-scan (Tekscan, Inc., Boston, MA). Each subject walked along an even floor at usual speed with the sensor sheet. Recordings were made three times at 50 Hz for five seconds. The feet were divided into eight regions: great toe, second and third toes, fourth and fifth toes, medial forefoot, central forefoot, lateral forefoot, midfoot, and hindfoot (Figure 1). Peak pressure (PP), contact area (CA), contact time (CT), and force-time integral (FTI) were measured in each region. The rate of the whole time from heel strike to toe off was adopted about CT. For each region, a mean value was compared between the HV and C groups. Statistical processing comprised the use of the Mann-Whitney U test, with the level of significance set at P < 0.05.

Results: PP (kgf/cm2) was significantly higher in the second and third toes, fourth and fifth toes, medial forefoot, central forefoot, and midfoot in the HV group (mean: 1.97, 1.38, 3.69, 6.22, and 1.28, respectively) than in the C group (mean: 1.21, 1.02, 2.10, 3.11, and 0.88, respectively) (Figure 2). CA (cm2) was significantly smaller in the great toe and the second and third toes in the HV group (mean: 4.68 and 4.37, respectively) than in the C group (mean: 7.03 and 5.58, respectively) (Figure 3). CT (%) was significantly shorter in the great toe and medial forefoot in the HV group (mean: 54 and 68.9, respectively) than in the C group (mean: 81 and 80.2, respectively) (Figure 4). FTI (%) was significantly lower in the great toe and hindfoot in the HV group (mean: 3.7 and 33.6, respectively) than in the C group (mean: 6.0 and 38.5, respectively), and significantly higher in the midfoot in the HV group than in the C group (13 vs. 7.5) (Figure 5).

Discussion: The present study demonstrated that CA, CT, and FTI of the great toe in the HV group were significantly lower than in the C group. These results suggested that feet with hallux valgus had the dysfunction of the great toe in the stance phase during walking. Regarding the central forefoot, PP in the HV group was twice as high as that in the C group, and CT and FTI appeared to have some increase in the HV group compared to the C group. We believe that functional impairment of the great toe leads to increasing mechanical loading in the central forefoot in feet with hallux valgus.

Significance: The present study demonstrated that a moderate-to-severe hallux valgus deformity has the dysfunction of the great toe during walking which can be a cause for increasing mechanical loading in the central forefoot.

Acknowledgments: none

3) Bryant A, et al. 1999. The Foot 9(3): 115-
Figure 1. The eight regions used in plantar pressure measurement (kgf/cm²)

Figure 2. Peak pressures in the HV and C groups

Figure 3. Contact areas in the HV and C groups
Figure 4. Contact times in the HV and C groups

Figure 5. Force-time integrals in the HV and C groups

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