Off-the-shelf in-shoe heel inserts: does cost matter?

A K Ramanathan, M C John, G P Arnold, L A Cochrane, R J Abboud

ABSTRACT

Objective: A growing exercise culture has lead to an increase in the use of off-the-shelf heel inserts. While there are a variety of designs in a spectrum of cost ranges, probably the ease of availability and cost would mainly determine the choice of purchase. This study was designed to determine whether expensive designs provide better pressure attenuation under the heel than their less expensive counterparts.

Participants and Design: Six brands of off-the-shelf heel inserts were tested. Selection of these was based purely on their availability in all sizes. Cost per pair ranged from £6 to £30. Thirty-five asymptomatic subjects walked on a 10 m walkway, once with no inserts and once with each pair of inserts. The Pedar in-shoe system recorded a range of parameters under the heel.

Setting: Institute of Motion Analysis and Research, Ninewells Hospital and Medical School, University of Dundee.

Main outcome measures: Evaluation of plantar pressure parameters under the heel.

Results: All inserts reduced peak pressure under the heel. Maximum force and pressure-time integral also decreased. Contact time generally increased with the use of inserts. Values of contact area with and without inserts were comparable.

Conclusions: No significant differences were observed under the heel between the pressure attenuation properties of the lowest-priced and the most expensive designs, and hence the less expensive inserts can be considered as good as the expensive brands. However, the endurance power of these inserts may differ and this should be evaluated.

Humans have evolved into highly-efficient bipeds. Using the lower limbs for locomotion and upper limbs for prehension has allowed humans to be more functional than other living beings. As a result of upright gait, the lower limb in general, and the foot in particular, take the major brunt of the intermittent and alternating impact at initial contact. Hence, during normal gait, the heel, being the point of initial contact with the ground, counteracts the ground reaction forces.

During normal gait, the foot is the only part of the body where exchanges of dynamic forces take place. The natural bony arches and ligamentous complex of the foot act as static shock absorbers. During heel strike, pronation of the subtalar joint, eversion of the calcaneus and the plantarflexion of the talus in relation to the calcaneus act as dynamic dampers of shock. As an average person walks 3 to 3.5 million steps per year, the heel pad undergoes changes of attrition and its shock-absorption capacity diminishes over time. Heel pad shock-absorbency could reduce by up to 24% due to repeated trauma. The latter may be the main reason for the increasing use of heel inserts.

Although the foot itself is an excellent first-contact shock-absorber, it is evident that other mechanisms assist the foot in this role. Muscles play an important role in shock-absorption by decelerating the limbs with eccentric contraction. The meniscus, intervertebral disc and bone also attenuate the incoming shockwaves generated at heel strike during gait. This is a natural phenomenon of absorption and dissipation of energy invading the body during initial contact of the gait cycle. The shock-absorbing capacity of subjects with healthy locomotor system is approximately 30% higher than that of subjects with diseases of the weight-bearing joints.

Heel inserts are known to reduce the shock generated at heel strike and are believed to dissipate the shockwave due to their viscoelastic nature. Heel inserts have been advised for people suffering from heel pain. The symptomatic relief of heel pain with heel inserts in over-use injuries (in professional and recreational athletes) has been documented. With the growing exercise culture, the use of heel inserts has been on the rise among the general public. A variety of designs are available over the counter but, in the absence of conclusive scientific evidence to favour one over another, the choice may depend on their availability and affordability. The aim of this study was to compare the effects of off-the-shelf in-shoe heel inserts of varying costs on parameters under the heel, in order to determine whether expensive heel inserts provided better pressure attenuation than cheaper models.

MATERIALS AND METHODS

Ethical approval was granted by the local Research Ethics Committee. Thirty-five participants were recruited: seven women (20%) and 28 men (80%). Subjects using walking aids and those with previous foot and ankle injuries and foot disorders were excluded from the study. The lower limbs of each subject were measured and there was no limb length discrepancy in any of them. The mean age was 34.6 years (21 to 50 years). All the participants were right dominant.

Six inserts were selected exclusively on the basis of their off-the-shelf availability in all sizes: silicone heel spur cup with central spot (Algeo’s, £6); Gelmax advanced gel and Poron design with extra thick poron centre (Profoot, £9.99); gel support silicone therapeutic under-heel (Zanni, £6.95); silicone heel cushions (Minigrip, £9.70); Viscosport viscoelastic heel cushions (Bauerfeind, £50) and WonderZorb medical grade biomechanical silicone heel cushions with soft density dots (Silipos,
observed between walks to prevent any carryover effects from the previous walk.

The Pedar mobile (Novel GmbH, Germany) in-shoe pressure system was used to measure the parameters under the heel (fig 2). The accuracy and repeatability of this system have been validated.41 2 Using the multimask evaluation software, the heel area was defined. Parameters chosen for analysis were peak pressure (PP) in kPa, contact time (CT) in ms and percentage roll over process (%ROP), contact area (CA) in cm², maximum force (MF) in N and pressure-time integral (PTI) in kPa.s.

STATISTICAL METHODS
Repeated measures analysis of variance was used to investigate the effects of within-subjects factors, sides and inserts on parameters measured under the heel. The Huynh–Feldt correction was applied for non-sphericity where appropriate. Contrasts were applied to identify differences between insert materials, in conjunction with the Bonferroni correction for multiple post-hoc comparisons. The significance level chosen was 5%.

RESULTS
See table 1. There were no significant differences between the sides for the various parameters considered. All the inserts reduced the PP, MF and PTI under both heels. PP and MF were significantly reduced by all inserts whereas the reduction in PTI was non-significant. PP was highest with Insert 6 and was significantly higher than with Insert 3 (p = 0.001), Insert 4 (p = 0.05) and Insert 5 (p = 0.001). PP was lowest with Insert 5. PTI was lowest with Inserts 4 and 5 and this value was significantly lower than that with Insert 6 (p = 0.002 and p = 0.004 respectively). There was an increase in CT (ms and %ROP) under both heels but this was significant in only one case (Insert 3 for CT (ms)). CA was marginally lower with all inserts compared with the “No insert” condition but none of the reductions were statistically significant, although significant difference was noted between Insert 2 and Insert 5 (p = 0.01), Insert 3 and Insert 6 (p = 0.01) and Insert 5 and Insert 6 (p = 0.002). As there were no significant differences between the right and left feet, the values were averaged and the percentage change in each variable has been depicted as a bar graph (fig 3).
DISCUSSION

All inserts demonstrated pressure-attenuating capabilities. Insert 5 (£30) was associated with the lowest PP while Insert 6 (£18.38) recorded the highest PP, and this was significantly higher than Insert 3 (£6.95), Insert 4 (£9.70) and Insert 5 (£30). All the inserts effected a statistically significant reduction as compared with the walk when no insert was used.

The maximum reduction in MF was with Insert 3 (£6.95) while the lowest reduction was with Insert 5 (£30). Although there is no statistical significance between the inserts, they were all statistically significantly different from the “No insert” condition.

Increases in both PP and CT will result in increased PTI. An increase in one variable, however, does not necessarily increase PTI, provided there is a decrease in the other of sufficient magnitude. In our study, although CT increased under the heel, PTI decreased due to the significant reductions in PP. These effects can be directly attributed to the use of inserts, and imply that pain under the heel would be reduced if it were pressure-related.

There were no significant differences in CT between inserts. PTI was lowest with Insert 4 (£9.70) and Insert 5 (£30) and highest with Insert 1 (£6). There was a statistically significant difference between Insert 4 (£9.70) and Insert 6 (£18.38) and between Insert 5 (£30) and Insert 6 (£18.38), with PTI being higher with Insert 6 on both occasions.

Often right and left feet of the same individual have different dimensions. This was evidenced by the observed CA values, where some inserts showed an increase and some a decrease between both feet in an inconsistent manner, although there was no significant difference between the feet. Interestingly, statistical significance was noted between some inserts; Insert 2 (£9.99) and Insert 5 (£30), Insert 3 (£6.95) and Insert 6 (£18.38) and Insert 5 (£30) and Insert 6 (£18.38). This emphasises the view that, ideally, inserts should be custom-made. However, production costs may be prohibitive.

None of the subjects were obese and all of them walked at their preferred self-selected speed to simulate a natural walking pattern.

CONCLUSION

The pressure-attenuating capabilities of heel inserts were evidenced by reductions in PP, MF and PTI under the heel. All inserts showed a statistically significant reduction in PP and MF under the heel. Although statistical significance was present between certain inserts, the reduction in PP with the least expensive insert was not significantly different from those with the more expensive designs. This outcome, along with the non-significance noted between the inserts with MF, suggests that the individuals should purchase the design that confines and complies well with their feet and footwear irrespective of cost. However, the endurance power of these inserts may differ and this should be evaluated.

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REFERENCES

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