

EFFECTS OF PADDING MATERIAL AND THICKNESS ON SECOND METATARSAL HEAD DISCHARGE

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Statement of Purpose

Padding is frequently used in clinical podiatry to reduce the contact pressure on a foot area, mostly under the second metatarsal head. Podiatrists can use several padding options, i.e., different materials combined with different thicknesses and hardnesses. However, to our knowledge, only one study has been performed to control the efficiency of padding (Curran JM 2015), showing a 25 % peak pressure decrease using a 7 mm felt padding. As a preliminary step to a clinical study including gait and foot morphology variability in podiatric patients, our purpose was to investigate the efficiency of different padding designs made of felt or hydrogel in a single normal subject. Measurements were made using a new validated plantar pressure device composed of nine independent sensors.

Design and Methods

Four materials employed in podiatry were used to manufacture five paddings with different thicknesses (thk in mm): Hapla Gold All Wool Felt, thk = {5; 7} (HGAWF5 and HGAWF7, respectively), Hapla Swan Foam, tkh = 5 (HSF5), Hapla Foam-O-Felt, tkh = 5 (HFOF5) and Hydrogel, tkh = 3 (H3). Each of the paddings had an auto-adhesive side to be fixed under the forefoot, and included a hole facing the second metatarsal head. One healthy subject was asked to walk on a 22 m long lane with his daily shoes. For analysis, ten consecutive gait cycles were recorded during (i) walking without padding, considered as the reference condition, and (ii) walking successively with each of the paddings. The pressure measurements were performed with the Winshoe device (Medicaptureurs, Balma, France) which comprises nine independent pressure sensors that were manually positioned on foot areas of interest: one sensor was placed on the second metatarsal head, six around the hole facing the second metatarsal head and two on the heel; all were fixed with double-sided auto-adhesive tacks. A comparison of collected data was performed with statistical significance set at $p < 0.05$.

Results and Conclusions

Only the results of the second metatarsal head discharge are reported here. H3 presented the greatest peak pressure reduction (73 %) when compared to the reference condition. The reduction with HGA5, HFOF5, HGA7, and HSF5 was of 39, 32, 30 and 25 % respectively. The associated peak pressure were different from those in both reference and H3 ($p < 0.05$). In particular, the comparison between HGA5 and HGA7 indicated that +2 mm thickness was not obviously efficient when using HGA material. The different 5 mm thickness paddings did not present similar results ($p < 0.05$) despite their identical thicknesses. This finding emphasized that the main padding characteristic to ensure efficient discharge is its material mechanical behaviour rather than its thickness. Hydrogel gave the best load reduction despite its lowest thickness, due to its viscoelastic behaviour which reacts in 3D while Hapla reacts only in compression.