WEAR OF DIFFERENT SHOE INSERTS – INFLUENCE ON BIOMECHANICAL RUNNING VARIABLES

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INTRODUCTION

Over the last years, various studies have reported non systematic effects of inserts and orthotics on biomechanical variables [1,2]. However these results are predominantly based on cross sectional studies. Longitudinal effects (e.g. wear) of inserts on biomechanical variables have not been reported. Therefore, the objectives of the present study were to determine the effects of different inserts and the influence of extended wear on biomechanical running variables.

METHODS

24 healthy male subjects (age: $\bar{x}$=25.1yrs, σ=2.7yrs; height: $\bar{x}$=176.7cm, σ=4.4cm; weight: $\bar{x}$=72.9kg, σ=6.1kg; shoe size=UK 8) participated in two different testing sessions (PRE, POST) at least 5 weeks apart. All subjects were rearfoot runners. A fixed running speed of 3.5m/s ± 0.1m/s was set and monitored using light barriers. A neutral running shoe was used for the tests (Puma Ceylon, EVA-midsole). Testing sessions consisted of 5 valid running trials for each of 5 insole conditions (S01-S05): 2 pairs of identical sports inserts (Manufacturer A, S01, S03), 2 pairs of identical sports inserts (Manufacturer B, S02, S04), and the stock insole of the Puma Ceylon (S05). All sports inserts were fitted into the Puma Ceylon by the same orthopedic technician. In contrast to the stock insole (3mm EVA foam), the sports inserts had an anatomical foot bed, medial support and consisted of a cork under layer and an EVA upper layer. Conditions were applied in randomized order. Between PRE and POST, S01, S02 and S05 were worn by running the inserts for 500km; S03 and S04 were not treated. For each trial, data were collected using a Kistler force plate, a tibia mounted uni-axial accelerometer and an electrogoniometer (frontal plane heel cup motion). All devices were hardware synchronized and sampled at 1000Hz. Force curves and goniometer curves were filtered by a 4th order zero lag digital Butterworth lowpass filter (force cutoff 100Hz, goniometer cutoff 50Hz). 17 discrete variables were calculated from the data of ground reaction forces, rearfoot movement and peak tibial acceleration. Every calculated value was visually controlled by plotting each analyzed curve, including all calculated values. 5 variables demonstrated adequate reliability [3] and remained for data analysis: PVF_1 (1st vertical force peak), FR_{max} (maximum vertical force rate), FR_{mean} (mean vertical force rate), PTA (peak tibial acceleration), and TPR (total pronation range). Depending on distribution characteristics, data were analyzed using parametric or nonparametric statistical procedures, modified measurement error calculations [4], eta² calculations, and power analyses.

RESULTS AND DISCUSSION

Within PRE, no significant differences were found between the insert conditions. Even SO5 (3mm EVA foam, no anatomical foot bed, no medial support) did not differ significantly from the sports inserts. Within POST, significant differences between the inserts were measured for FR_{max}, FR_{mean}, PTA & TPR. However, the changes of PTA & TPR did not exceed the 95% CI for repeated measurements [3]. The post-hoc tests for FR_{max} and FR_{mean} had low powers at .05 α-level (mean power=.5, range=.27-.69). The significant changes within the POST test were therefore judged as random artifacts. Between PRE and POST, PVF_1 decreased significantly for S01 (eta²=.18). However, the power analysis (α-level=.05) for the corresponding test revealed a low power of .52, hence this decrease was also judged as a random artifact.

In summary, neither effects of different inserts on the evaluated biomechanical running variables nor an effect of wear on these inserts could be demonstrated. Descriptive statistics showed large differences in intra-subject and between-day variability (e.g. Figure 1). Two-way ANOVAs (factors: 'subject', 'insert') for variables PVF_1, FR_{max} and FR_{mean} (POST) displayed the effects of large intra-subject variability. Factor 'subject' explained 83-86% of the total variance (SS_{total}). However factor 'insert' could only explain 1-4% of SS_{total}.

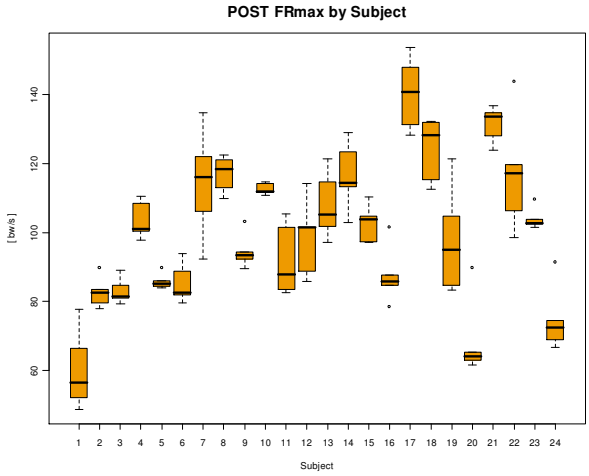

Figure 1: Boxplots of FR_{max} by subject for POST test.

CONCLUSIONS

Looking for differences between inserts in data, mainly characterized by effects of intra-subject and between-day variability of subjects, will probably not lead to reasonable results. Basic research is needed to analyze and understand the large differences in intra-subject and between-day variability of subjects.

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