EFFECTS OF RUNNING SHOES WITH DIFFERENT MIDSOLE HARDNESS ON BIOMECHANICAL VARIABLES WHILE TREADMILL RUNNING

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INTRODUCTION

Nowadays many people run on treadmills at home or in fitness clubs. Comparisons between overground and treadmill running have shown differences in kinematic and kinetic variables [1,2,3]. Several authors investigated if treadmill running requires specific running shoe models [4]. Concluding that less cushioning is acceptable for treadmill running shoes [4], lower impact shock variables and loading pattern were shown during treadmill running[1].

Therefore, the purpose of this study was to analyze how different midsole hardness affects selected biomechanical variables during treadmill running compared to overground running.

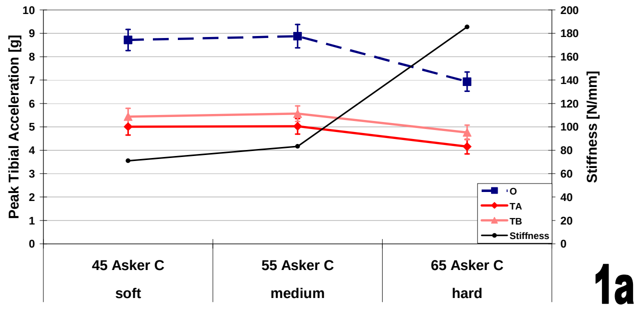
METHODS

Twenty male recreational runners (25.5yrs +/- 4.5; 175.9cm +/- 4.1; 73.4kg +/- 6.8) ran at 3.5m/s (+/- 0.1) overground (O) and on two different treadmills (Trackmaster TM310 (TA); TechnoGym RunExc500 (TB)) while wearing three identical running shoes except for their different midsole hardness (45, 55 and 65 Asker C). Tibial acceleration was measured with a miniature accelerometer (ADXL-78). An electrogoniometer (Megatron MP10 1kOhm) was used to determine rearfoot motion. Analog signals were sampled at 1kHz. Five repetitive trials for overground running and 10 consecutive strides for running on each treadmill were recorded for each shoe condition and for the right leg. For treadmill running an additional accelerometer (ADXL-84) was attached to the heel counter of the running shoes for triggering foot strike. Mean values were calculated for peak tibial acceleration [g] (PTA), maximum pronation angle [°] (MPA) and maximum pronation velocity [°/s] (MPV). A mechanical test (servohydraulic impacter; Zwick/Roell HC10) was performed by vertical application of a loading profile according to force-time characteristics of a heel-to-toe specific running speed of 3.5 ms^{-1} to analyze the stiffness of the heel area. A two-way ANOVA was used to analyze the effect of running surface and footwear conditions (α=0.05).

RESULTS AND DISCUSSION

The mechanical test showed that shoe stiffness did not behave linear (Figure 1). The hardest shoe condition (65 Asker C) had a substantial higher stiffness than the other two shoe conditions. These non-linear results are also found in the biomechanical measurements (Figure 1).

Biomechanical testing revealed lower PTA for running on both treadmills in comparison to overground running (Figure 1a). This may be due to a cushioning effect of the treadmills and a flatter foot position of the subjects at foot strike as reported in literature [1,2,3]. Remarkably, for overground as well as for treadmill running the lowest PTA was measured for the hardest shoe condition ($p<0.001$). This fact leads to the assumption that runners changed their running style to avoid high impacts in harder shoes [5]. For MPA and MPV no significant differences between overground and treadmill running were observed. MPA was slightly reduced (p=0.003) and MPV was strongly increased (p=0.001) when running in the stiffest shoe condition on all surfaces (Figure 1b). No adapting behaviour was obvious. The results for the PTA and rearfoot motion data correspond to those in literature [1].



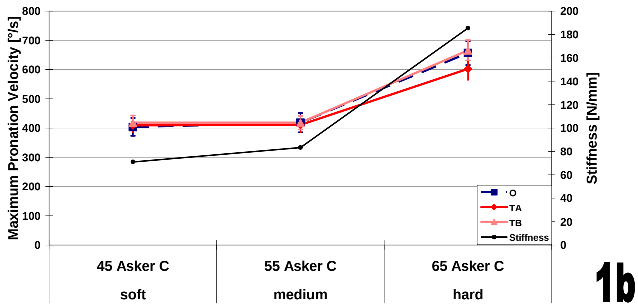


Figure 1: (a) PTA and (b) MPV of all shoe conditions for overground and treadmill running.

CONCLUSIONS

The present study showed that the usage of less cushioned shoes for treadmill running should be considered carefully. Changes in midsole hardness may have great effects on biomechanical variables. Impact load was shown to be reduced on treadmills and wearing hard shoes (65 Asker C) for overground and treadmill running. An adapted running style was supposed. An adaptation behavior in rearfoot motion may not be possible as it is supposed by Schlee et al. (2009).

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