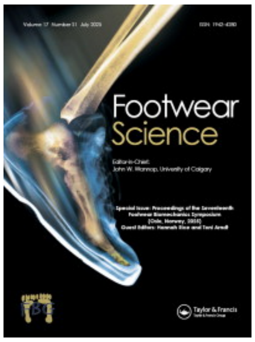

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ABSTRACT

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Effects of upper reinforcement in basketball shoes on ankle mechanics during a 135° cutting movement

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KEYWORDS Basketball shoes; cutting movements; ankle mechanics; shoe upper; ground reaction force

Introduction

Cutting movements are a key component of the game of basketball with the ankle joint being an important consideration due to the increased loading of ankle joint and risk of ankle inversion injuries (Kristianslund et al., 2011). The influence of basketball shoes on ankle mechanics during cutting movements has previously focused on midsole interventions (Cong & Lam, 2021) or upper interventions that only included local reinforcements (Liu et al., 2022). However, there is limited knowledge on global upper reinforcements in basketball shoes and how this could influence the ankle joint during cutting movements.

Purpose of the study

The purpose of this study was to investigate the effects of global upper reinforcement in basketball shoes on ankle mechanics during a 135° cutting movement.

Methods

Nine participants (age: 32.11 years ± 5.75, mass: 83.87 kg ± 6.04, height: 1.86 m ± 0.10) were recruited for this study. Participants were all active in sports that involve dynamic cutting movements (including basketball, soccer, and American football) and had a shoe size between UK 5.5 and UK 14.5. Participants completed 135° cutting movements in two footwear conditions. The two footwear conditions were created using the adidas Dame 8 basketball shoe, where the control condition had no modifications and the stiff upper condition had all elements the same but with an upper that was reinforced with a material laminated to the entire backside. Participants were instructed to perform this movement at 80% of game intensity and approach velocity was monitored (± 0.2 m/s). Markers were placed on the shank and foot and collected at 200 Hz using a 12-camera motion capture system. Force data was collected via an AMTI force plate at 1000 Hz. Statistical parametric mapping (SPM) and paired t-tests ($\alpha = 0.05$) for peak values were performed on ground reaction forces (GRF) and ankle metrics.

Results

There were significant differences found for peak ankle eversion moment ($p = 0.014$) and peak ankle frontal plane absorption power ($p = 0.035$) but no difference in peak ankle inversion angle ($p = 0.668$), peak ankle inversion velocity ($p = 0.936$) or peak lateral GRF ($p = 0.056$) (Table 1). However, SPM analysis did not reveal any differences between the two footwear conditions for any of the analysed variables (Figure 1).

Discussion and conclusion

The stiff upper condition resulted in an increased peak ankle eversion with a simultaneous increase in negative power in the frontal plane of the ankle joint. This was an unexpected result as it was hypothesised that the increased upper stiffness would reduce the demand on the ankle joint by creating a more stable platform to contain the foot. However, these findings suggest an increased demand on the ankle joint, which may have a negative impact on both

Table 1. Peak values for ankle and GRF metrics. Mean (SD). * denotes significantly different from control at $p \leq 0.05$.

	Control	Stiff upper	*p*-value
Ankle inversion angle [deg]	29.48 (4.97)	29.89 (5.12)	$p = 0.668$
Ankle inversion velocity [deg/s]	760.08 (207.93)	759.98 (175.84)	$p = 0.936$
Ankle eversion moment [N·m/kg]	−1.29 (0.40)	−1.51 (0.49)*	$p = 0.014$
Ankle frontal-plane absorption power [W/kg]	−10.10 (4.12)	−12.37 (5.55)*	$p = 0.035$
Lateral GRF [N]	1211.93 (283.89)	1289.70 (314.11)	$p = 0.056$

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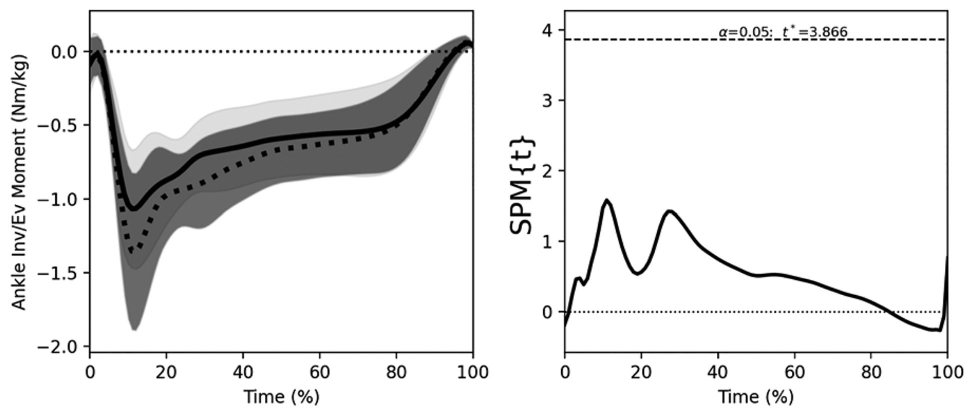

Figure 1. a) Mean ankle inversion-eversion moment for control (black) and stiff upper (dashed) conditions. b) The paired samples t-test statistic SPM {*t*}.

performance and injury risk. A large but non-significant difference in peak lateral GRF appears to be driving this change in moment and power. This increase may have been due to participants feeling more confident in the stiff condition and subsequently applying a larger lateral load (6/9 participants preferred the stiff condition), which could benefit cutting performance. Further, the lack of findings in the SPM approach is likely due to the amount of individual subject variability observed across footwear conditions, which may suggest that individuals have different movement patterns for this cutting movement and may respond differently to the footwear conditions.

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