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ORIGINAL RESEARCH

MODIFYING MIDSOLE STIFFNESS OF BASKETBALL FOOTWEAR AFFECTS FOOT AND ANKLE BIOMECHANICS

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ABSTRACT

Background: There is a growing incidence of foot injuries in basketball, which may be from the sport's repetitive, forceful multi-directional demands. Modifying midsole stiffness of the basketball shoe has been reported to alter ankle motion and plantar forces to reduce the risk of injury; however, the effects on anatomical, in-shoe foot (metatarsal), motion is not well understood.

Purpose: The purpose of this study was to identify differences in foot and ankle biomechanics between basketball shoes with differing midsole stiffness values during single-leg jump landings. It was hypothesized that a stiffer midsole would elicit lower 1st metatarsophalangeal joint (MTPJ) dorsiflexion angles, higher ankle dorsiflexion angles, and higher plantar forces and relative loading in the distal foot.

Study Design: Experimental cross-sectional study.

Methods: Twenty high school and collegiate-aged basketball players performed a single-leg side drop jump and a single-leg cross drop jump in a pair of standard basketball shoes and a pair of shoes modified with a fiberglass plate to increase midsole stiffness. Three-dimensional motion analysis and flexible insoles quantified foot and ankle kinematics and plantar force distribution, respectively. Separate 2 (footwear) x 2 (task) repeated measures ANOVA models were used to analyze differences in 1) ankle kinematics, 2) 1st metatarsophalangeal kinematics, 3) maximal regional plantar forces, and 4) relative load.

Results: The stiffer shoe elicited decreased peak ankle plantarflexion (mean difference = 5.8°, $p = 0.01$) and eversion (mean difference = 6.6°, $p = 0.03$) and increased peak ankle dorsiflexion angles (mean difference = 5.0°, $p = 0.008$) but no differences were observed in 1st MTPJ motion ($p > 0.05$). The stiffer shoe also resulted in lower peak plantar forces (mean difference = 24.2N, $p = 0.004$) and relative load (mean difference = 1.9%, $p = 0.001$) under the lesser toes.

Conclusions: Altering the midsole stiffness in basketball shoes did not reduce motion at the MTPJ, indicating that added stiffness may reduce shoe motion, but does not reduce in-shoe anatomical motion. Instead, a stiffer midsole elicits other changes, including additional ankle joint motion and a reduction in plantar forces under the lesser toes. Collectively, this indicates that clinicians need to account for unintended compensations that can occur throughout the kinetic chain when altering a shoe property to alleviate a musculoskeletal injury.

Level of Evidence: 2b

Keywords: Basketball, midsole stiffness, metatarsal injury, jumping

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