

Influence of Forefoot Bending Stiffness on Metatarsophalangeal Joint Kinematics, Kinetics and Performance of American Football Players

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Abstract

Hyperextension of the metatarsophalangeal (MTP) joint results in a common American football injury known as 'turf-toe'; the tearing of the plantar capsule-ligament¹. One variable that is possibly related to turf-toe is the longitudinal bending stiffness of the forefoot of football cleats². It is speculated that cleats with low forefoot bending stiffness allow the MTP joint to extend too much during play, resulting in dangerous strain on the plantar capsule-ligament. The purpose of this study was therefore to investigate if increasing forefoot bending stiffness of American football cleats can help protect the MTP joint from hyperextension without negatively affecting performance. Ten football players performed four maximal effort football movements (5-10-5 agility drill, 5 m sprint, broad and vertical jumps) on artificial turf installed in the laboratory. Each movement was performed three times in three different cleat conditions that varied only in forefoot bending stiffness; low (12.7 N/mm), moderate (23.8 N/mm), and high (42.4 N/mm). The artificial turf installation allowed for the collection of 3-D kinetic and kinematic data necessary to analyze MTP joint angles and moments. The performance of each movement was quantified. The sprint start and the broad jump were associated with the largest MTP extension angles (approximately 33 deg and 43 deg, respectively). For both of these movements, peak MTP extension angle was decreased with the stiffer shoes. This was not true for the agility drill or vertical jump; however, the peak MTP joint extension angles for these movements were relatively small (<18 deg). The MTP moment data are currently being analyzed. For all four movements, increasing forefoot stiffness did not negatively affect performance. The results of this study thus far indicate that increasing forefoot bending stiffness in American football cleats may be a viable way to help protect the foot from turf-toe without compromising performance.

References

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