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The Effect of the Shoe-Surface Interface in the Development of Anterior Cruciate Ligament Strain

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ABSTRACT | REFERENCES (51)

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The shoe-surface interface has been implicated as a possible risk factor for anterior cruciate ligament (ACL) injuries. The purpose of this study is to develop a biomechanical, cadaveric model to evaluate the effect of various shoe-surface interfaces on ACL strain. There will be a significant difference in ACL strain between different shoe-surface combinations when a standardized rotational moment (a simulated cutting movement) is applied to an axially loaded lower extremity. The study design was a controlled laboratory study. Eight fresh-frozen cadaveric lower extremities were thawed and the femurs were potted with the knee in 30 deg of flexion. Each specimen was placed in a custom-made testing apparatus, which allowed axial loading and tibial rotation but prevented femoral rotation. For each specimen, a 500 N axial load and a 1.5 Nm internal rotation moment were placed for four different shoe-surface combinations: group I (AstroTurf-turf shoes), group II (modern playing turf-turf shoes), group III (modern playing turf-cleats), and group IV (natural grass-cleats). Maximum strain, initial axial

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biomechanics, stress-strain relations

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force and moment, and maximum axial force and moment were calculated by a strain gauge and a six component force plate. The preliminary trials confirmed a linear relationship between strain and both the moment and the axial force for our testing configuration. In the experimental trials, the average maximum strain was 3.90, 3.19, 3.14, and 2.16 for groups I–IV, respectively. Group IV had significantly less maximum strain ($p<0.05$) than each of the other groups. This model can reproducibly create a detectable strain in the anteromedial bundle of the ACL in response to a given axial load and internal rotation moment. Within the elastic range of the stress-strain curve, the natural grass and cleat combination produced less strain in the ACL than the other combinations. The favorable biomechanical properties of the cleat-grass interface may result in fewer noncontact ACL injuries.

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