Design of a System for Prevention of Anterior Cruciate Ligament Injuries

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Abstract: NCAA athletes have a 13% chance of tearing their anterior cruciate ligament (ACL), the main stabilizer in the knee. Non-contact ACL injuries make up 70% of total ACL tears; these decompose into 5 failure mechanisms. The abduction/adduction (9%) and flexion/extension (37%) failure mechanisms are addressed in this paper. A kinematic model of the equations of motion confirms flexion angle, ground reaction force, and q angle are the main contributors to these failure mechanisms. Two wearable devices to counteract and provide bio-feedback of the estimated shear force and torque has been designed for each mechanism respectively. To develop and test the device will require an initial investment of $468,266 with a breakeven point after sales start just below 2 years. It is estimated that this device would lower the probability of a tear from 13% to 7% amongst NCAA athletes, and reduce medical costs to insurance companies by $52.5M per year.

Keywords: ACL, Anterior, Cruciate, Ligament, Tear, Abduction, Adduction, Flexion, Extension Prevention