A Fall Simulator to Investigate the Efficacy of Personal Protective Equipment

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ABSTRACT

The wrist and distal forearm is the most commonly fractured region of the upper extremity. Most of these fractures are the result of a fall event where the natural response is to break the fall with an outstretched hand. To prevent fractures during falls that occur while a participant is engaged in activities such as rollerblading or snowboarding, participants are encouraged to wear wrist guards. However, there is debate regarding the efficacy of wrist guards in preventing wrist fractures. To investigate the design of wrist guards and improve the efficacy of personal protective equipment, a device is required that will accurately replicate multiple fracture scenarios. The aim of this paper is to discuss the development and validation of a fall simulation device. The fall simulator provides multiple configurations of fall height, impact angle, and arm orientation during impact. The simulator uses compressed springs as the propulsion mechanism for the impact. The design allows for simulation of various elbow and shoulder movement through a custom attachment. A major focus of this work is the validation of the simulation device. Using the Qualisys Motion Analysis system and an AMTI force plate, the kinetic and kinematic characteristics of the system will be evaluated. Of particular interest are the velocity profile of the system, the force at impact and the acceleration characteristics of the system. Multiple trials at various configurations will be conducted and a statistical analysis will be conducted to confirm the accuracy and reliability of the system. The collected data will also be compared to published fall data to ensure the appropriateness of the fall scenario.