Incorporating an Articulating Facemask Into a Multi-Directional Self-Centering Linear Damping Football Helmet System

Pizzolato, Rachel (School: Elearning Academy)

The purpose is to determine the potential to reduce linear acceleration and tangential velocity during front and rear oblique impacts of a football helmet facemask. Independent Variables: Non-articulating Facemask Design (Control);Articulating Facemask Design Dependent Variables: Acceleration (m/sec2);Tangential Velocity (m/sec) A facemask was constructed using a novel 3D printed multi-directional self-centering damping system with 4 independent articulating attachment points that mimic the 4-wheel independent suspension system found in many modern automobiles, as well as biomimicry of a woodpecker's beak and shock absorbing properties of its skull. A t-test was used to determine significance between group means. Articulating designs showed significant ($p < .01$) reductions in acceleration and tangential velocity vs. (Control) at all sensor positions. Articulating designs significantly outperformed the non-articulating design with average %Δ in tangential velocity at the front of headform of -8.34% (front oblique impacts), and -5.63% (rear oblique impacts), and at the back of head form of -10.61% (front oblique impacts), and -18.84% (rear oblique impacts). This suggests the experimental design has potential to reduce incidences of concussions and cumulative effects of repetitive impacts - a leading cause of Chronic Traumatic Encephalopathy (CTE). Further improvements include incorporating lightweight, high-tech materials such as graphene and magnesium infused with ceramic silicon carbide nanoparticles into the facemask and damping design. The technology has far-reaching implications for automotive and motorcycle racing, construction, military, and aerospace applications, along with areas with limited space and where multi-directional damping is desired.

Awards Won:

Third Award of $1,000