Biomimicry of Woodpecker Anatomy to Improve Helmet Design in Prevention of Chronic Traumatic Encephalopathy

Oei, John (School: East Catholic High School)

Chronic traumatic encephalopathy (CTE) is an incurable neurodegenerative disease affecting people who have had repetitive concussive events. In a 2017 study, 99% of former NFL players observed had CTE. Over 3.8 million concussions are recorded per year in the United States, with 2.5 million of them being student athletes. A woodpecker has the ability to withstand the force of approximately 1,000 gs when pecking wood without substantial brain damage. A woodpecker does so 20 times per second, 12000 times per day. In comparison, a football player experiences a typical concussion at 95 g's. The tri-layer padding system designed was inspired by the woodpecker's unique anatomy. This included a combination of sorbothane, a shock absorbing material that converts energy to heat, to mimic the ability of a woodpecker's brain to convert energy to heat; Neoprene to mimic the spongy layer of the woodpecker's skull; and viscoelastic memory foam, which will keep the helmet close to the skull, to mimic the small space between the woodpecker's brain and the spongy. The average percent energy dissipated by the tri-layer protective system is 70%, compared to an average of 16% by the padding currently used. Thereby, a hit of 95 g's (3,040 lbf-ft) will be reduced to 28 g's (900 lbf-ft). This is below the average hit by a football player of 49 g's (1600 lbf-ft). The tri-layer protective system significantly absorbs the amount of energy from a collision as compared to the current protective system used by standard football helmet

Awards Won: