Cell-Pack Fitted Helmet for Enhanced Head Protection

Lead Investigators

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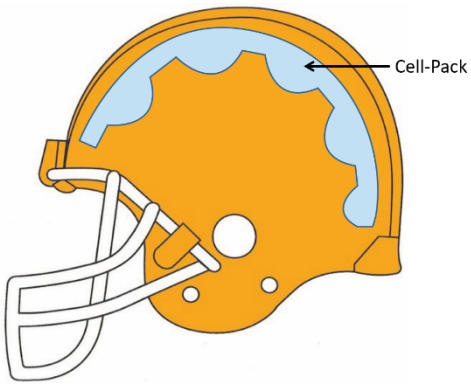
Background and Unmet Need



Concussive injuries in professional, club, and amateur sports, as well as across military occupations, are a major concern. Amateur athletes, including equestrian, contact sports, roller sports, and skiing, have been identified as one of the most susceptible populations to sustaining Traumatic Brain Injury (TBI).[1] Further, 45% of TBI-related emergency pediatric visits result from an injury sustained during contact sports.[2]

In professional, club, and amateur sports, TBI is a concern due to the increased awareness of chronic traumatic encephalopathy (CTE). CTE is a progressive degenerative disease that is known to result from repetitive concussive and sub-concussive traumas. Military service members are also a vulnerable population to sustain TBI. An estimated 15.2% to 22.8 % of service members have sustained a TBI, equating to an estimated 320,000 troops throughout the conflicts in Iraq and Afghanistan.[3]

The protective element in current helmet designs consists of inner foam liners for their shock-absorbing properties. However, as those repeatedly endure impact loading cycles, the performance of these liners degrades. Further, traditional air bladders, currently widely used in football helmets, must be inflated to optimal levels and maintain proper air pressure over time. Therefore, the necessary protection largely relies upon the proper maintenance and durability of helmet liners. As a result, there is a need for new technology that is easier and more efficient to maintain and while providing effective protective performance.

Opportunity

Drs. Wu and Li have developed protective headgear with cell pack integration, offering many advantages over the current State-of-the-Art foam liners.

Foam liners degrade quickly after repeatedly enduring impact load cycles. Because the Wu Li Cell-Pack does not rely on straining a solid structure and instead absorbs and dissipates the energy, it is believed that this technology has advantages in both protection and durability. Furthermore, this technology may be incorporated into several helmet designs, including, but not limited to sport, motor vehicle, bike, and military head protective gear.

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[1] *Trends in Emergency Department Visits for Contact Sports–Related Traumatic Brain Injuries Among Children — United States, 2001–2018.* Centers for Disease Control and Prevention, July 2020.
[2] Ibid.,
[3] *Military-related traumatic brain injury and neurodegeneration.* National Library of Medicine, June 2014.

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The Cell-Pack is embedded into the helmet's shell, replacing traditional liners. Upon impact, the fluid in the cell network is forced to redistribute to accommodate the suddenly imposed relative motion between the wearer's head and the shell. This redistribution process dissipates the impact energy by the fluid's viscosity. Further, the embedded Cell-Pack's design parameters are optimized towards tolerable and safe sustained acceleration levels, which constitute the main determinant of the impact's aftermath. Overall, this technology enables fine-tuning of the Cell-Pack liner to optimize protective performance.

Applicable markets for the Wu and Li technology include, but are not limited to, sports, motor vehicles, military, and industrial head protective equipment. The football helmet market was valued at 160 million in 2021 and is expected to reach $185.57 million by 2030 with a CAGR of 1.83%.[4] The motorcycle helmet market was valued at $2.287 Bn in 2022 with a CAGR of 6.8%.[5] The safety helmet market size was valued at $3.9 Bn in 2021 and is anticipated to grow at a CAGR of 7.6%.[6]

Growing concern as well as research related to TBI and other injuries, such as chronic traumatic encephalopathy (CTE), will continue to drive demand for better and more protective solutions.

Unique Attributes

- Biomimetic Cell-Pack design
- Enhanced material durability compared to standard foam liners
- Universally compatible with any helmet configuration

Applications

This technology may be incorporated into several helmet designs, including, but not limited to, sport, motor vehicle, bike, industrial, and military head protective gear. Inventors currently are considering post-surgical care as a possible use.

Stage of Development

Prototype and Proof of Concept.

Intellectual Property

Provisional patent application filed June 2024.

Licensing and Collaboration Opportunity

Villanova University is actively seeking a licensee or partner to support the development or commercialization of the technology presented.

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[4] *Global Football helmet Market Size*… Verified Market Research, June 2022.
[5] *Motorcycle Helmet Market Size,* Grand View Research, August 2023.
[6] *Safety Helmets Market Size*, Grand View Research, 2022.