HEALTH

Preventing Traumatic Brain Injury

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Motor vehicle accidents account for more than half of the 1.5 million traumatic brain injuries (TBIs) that occur each year. Finding ways to prevent, treat, and repair TBIs is the basis for the research of Barclay Morrison and his Neurotrauma and Repair Laboratory team.

At the moment of injury, some brain tissue is instantaneously destroyed and can never be saved by post-injury treatment, so prevention becomes all the more important. Using an atomic force microscope, Morrison is measuring material properties of anatomical structures within the brain that can be used by the National Highway Traffic Safety Administration to set standards for automotive manufacturers.

"We're determining the safe limits of brain deformation, which is the underlying cause of TBI, to learn what the brain can withstand, so safety systems can be designed to minimize the trauma," said Morrison.

Morrison's group is also working with the aftermath of TBIs. One approach investigates the brain's own initial response, which is an attempt to repair the damaged neural connections and replace lost tissue. For reasons yet unknown, this repair process is aborted. If Morrison can find a way to short-circuit this response, it may be possible to harness and control the brain's innate potential for repair. It may even be possible to grow replacement neural tissue from a patient's own stem cells via neural tissue engineering.

In a scenario directly from "The Six Million Dollar Man" or "The Bionic Woman," Morrison sees the possibility of interfacing neurons directly onto silicone circuitry to control a prosthesis. While this technology is now only imagined, he continues to investigate the factors that influence the ability of neurons to form connections with silicone circuitry, hoping for a breakthrough that can immediately impact the lives of thousands.

WIRED magazine explored this research in the spring of 2010: "Engineers have now designed silk-based electronics that stick to the surface of the brain, similar to the way a silk dress clings to the hips. The stretchable, ultrathin design would make for better brain-computer interfaces (BCIs), which record brain activity in paralyzed patients and translate thoughts into movements of computer cursors or robotic arms."

"This will significantly improve recording by conforming the electrode array to the surface of the brain," Morrison said in the article. "It will move forward the field of flexible electronics."

Before coming to Columbia Engineering, Morrison was a postdoctoral researcher in TBI at the University of Pennsylvania and later at the University of Southampton, U.K.

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