

# Multiple mild concussions have a cumulative, lasting effect

July 23 2012, By Erin Tornatore

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(Medical Xpress) -- Repeated concussions, even mild ones, can result in profound problems with learning and memory, suggests a study led by William Meehan, MD, director of the Sports Concussion Clinic at Boston Children's Hospital, and Michael Whalen, MD, director of the Acute Brain Injury Laboratory at MassGeneral Hospital for Children. Using a mouse model, the study documents cumulative, long-lasting impairment of brain function after repeated mild concussions, especially when they occur in close succession.

The study, conducted at Massachusetts General Hospital, also suggests that the more time allowed for recovery between concussions, the lower the likelihood of long-term impairment of brain function. Results appear in the journal *Neurosurgery* (online June 27).

According to Meehan and Whalen, the findings support the practice of keeping concussed athletes out of play until they recover. "Our model showed that even concussions that individually have no demonstrable effect on brain function can have profound detrimental effects if repeated, especially multiple times at close intervals," says Meehan, first author on the paper and also director of research for the Brain Injury Center at Boston Children's.

Meehan, Whalen and colleagues at Massachusetts General Hospital compared cognitive function in a total of 156 [mice](#) that sustained different numbers of mild concussions (while under anesthesia to avoid pain at the time of injury) at different time intervals. To test cognitive

function, they had the mice swim through a Morris water maze and find a hidden platform using spatial memory.

The findings:

- After a single concussion, injured mice performed as well as uninjured control mice (which were also anesthetized) in the maze.
- After three concussions, the injured mice performed worse than controls; this became markedly worse after five concussions.
- When mice sustained a series of five concussions, they performed worse than controls when the concussions were one day or one week apart. But when concussions were one month apart, they performed just as well after the fifth concussion as the uninjured mice.
- Concussions sustained at short time intervals had long-term effects: Even after a month-long recovery period, mice that sustained a total of five concussions at daily and weekly intervals continued to perform worse than uninjured mice. One year later, those sustaining concussions just a day apart still performed worse than controls.

Concussion is a disturbance of normal [brain function](#) that results from rapid rotational acceleration of the brain. While there is no visible structural injury (no bleeding, swelling or visible changes on CT or MRI), cognitive effects are immediate and can include blunted reaction time, slowed thinking and difficulty learning. If there is no further injury and athletes are allowed both physical and cognitive rest, most will recover on their own over time.

“We found that there is a vulnerable time frame in which multiple concussions, even if they are mild, can cause long-term and likely permanent cognitive deficits,” says Meehan. “Our findings support the

idea that athletes should be allowed time for full recovery after a concussion before returning to play. They need to have protected rest time.”

“A critical question that remains unanswered, however, is exactly how much rest time an individual player needs between concussions to avoid long-term effects on cognition,” says Whalen, the paper’s senior author. “This safe rest time is likely related to concussion severity, number, and genetic makeup of the individual.”

Previous published studies suggest that younger athletes—high school as compared with college athletes, for example—may be slower to recover from [concussion](#).

Provided by Children's Hospital Boston

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