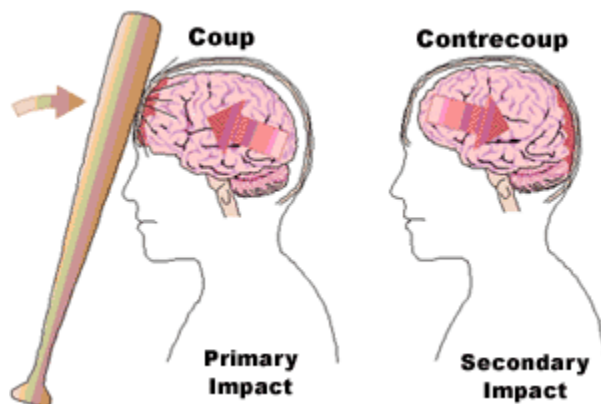


How Can the Brain Be Injured?

In the United States traumatic brain injury (TBI) is a leading cause of death for persons under age 45. TBI occurs every 15 seconds. Approximately 5 million Americans currently suffer some form of TBI disability. The leading causes of TBI are motorvehicle accidents, falls, and sports injuries. While the brain is by far the most complex object on earth, it is soft and vulnerable with a consistency of firm pudding.



Coup - Contrecoup Injury

Two image illustration showing coup caused by the primary impact and the secondary impact or contrecoup injury.

A concussion is a sudden trauma-induced alteration of the alert state. The person may be unable to concentrate or be confused for a few seconds, or completely lose consciousness and fall down. The brain is capable of recovering from a concussion. How much force is necessary to cause permanent brain damage is under study, and hence still unclear. Over the years, professional boxers suffer permanent brain damage. The force of a professional boxer's fist is equivalent to being hit with a 13 pound bowling ball traveling 20 miles per hour, about 52 g's. Plopping down into an easy chair can generate up to 10 g's. So, it seems that somewhere between 10 and 50 g's is the threshold to permanent brain injury. This does not mean that accelerations over 50 g's have to cause permanent brain damage. Football players are subjected to 200 g's, and Indy race car drivers have been subjected to 80 g's without permanent injury, but they were wearing helmets.

Football players and race car drivers also protect their heads from being whiplashed. Whiplash seems to be particularly damaging to the brain. Woodpeckers smack their heads against trees with 1200 g's of force without suffering brain damage. Part of the reason is that they keep their heads in the plane of their body; the head does not rotate in

a "yes-no" manner during the pecking. If there were some way to stabilize the head when driving - akin to wearing a mail suit from the Middle Ages - more people would walk away from automobile accidents without serious brain injury.

The brain is vulnerable to traumatic damage in two ways. The cerebral cortex can become bruised - contused - when the head strikes a hard object (or a hard objects strikes the head). Or, the deep white matter can suffer diffuse axonal injury when the head is whiplashed without hitting a hard object (or being hit by one). In serious whiplash injuries, the axons are stretched so much that they are damaged.

Cerebral contusions tend to occur at the tips of the frontal and temporal lobes where they bang up against the interior of the skull. Diffuse axonal injury occurs more toward the center of the brain where axons are subjected to maximal stretching.

