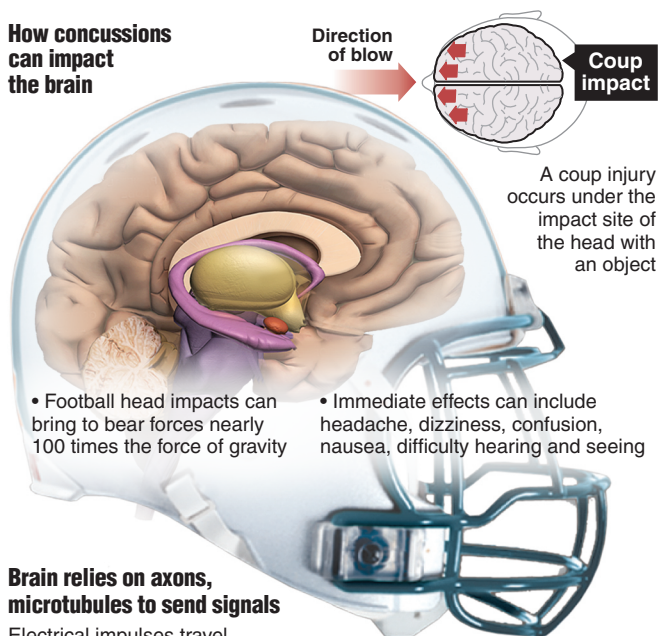


CTE injuries in NFL players

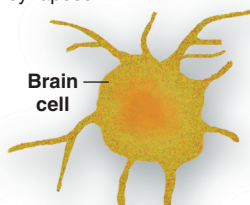
Chronic traumatic encephalopathy is a degenerative neurological disease that can affect athletes in hard-contact sports, especially football and boxing. Repeated blows to the head may eventually cause symptoms, such as slurred speech, tremors and confusion. Depression and suicidal tendencies have also been noted.

How concussions can impact the brain



Brain relies on axons, microtubules to send signals

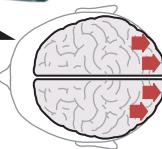
Electrical impulses travel along axons to nerve synapses



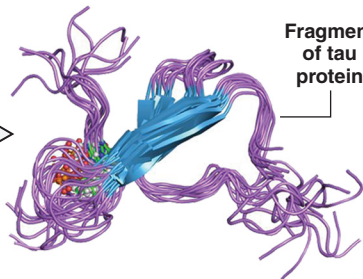
Countercoup impact

Direction of blow →

Countercoup injury occurs on side of head opposite the impact

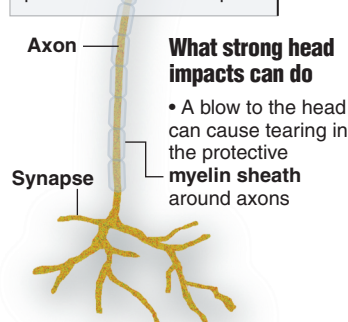


Fragment of tau protein

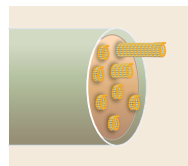


Key role of tau proteins

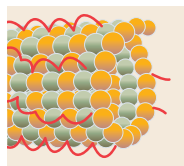
- Tau proteins are needed to provide stability to tiny pathways within axons called microtubules
- When tau breaks down, dementia or cognitive problems often develop



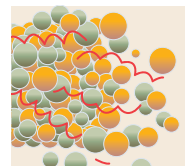
How CTE destroys brain cells



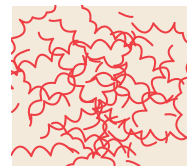
- In brain axons, microtubules carry electrical signals from cell to synapse



- Repeated blows to the head cause modifications to tau proteins

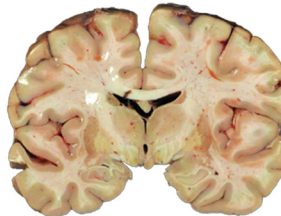


- Tau proteins detach from microtubules, causing them to fall apart



- Tau strands then bind to form tangled masses, killing the brain cell

Brain tissue comparison

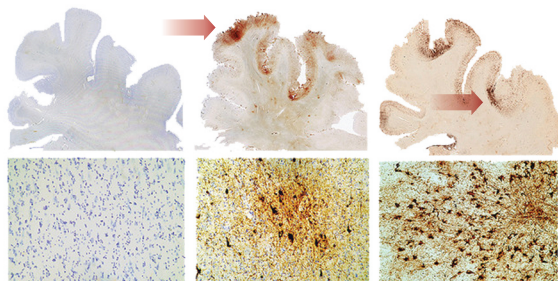


- Cross section of a normal brain, part of a database maintained by researchers at Boston University



- Cross section of a brain showing advanced CTE; tau protein deposits cause brain to shrink, become brittle

Dark deposits of tau proteins shown in samples



- Sample from a normal brain, of a 65-year-old person, with magnified detail

- Sample from brain of John Grimsley, an NFL veteran who died at age 45; tau deposits showing

- Sample from the brain of a deceased boxer, age 73 at death; suffering from extreme form of CTE damage

Deposits shown under greater magnification

