

## Understanding Concussion

*Kerry R. Crone, M.D., F.A.A.N.S*  
*Professor of Neurosurgery and Pediatrics*  
*Director, Resident Training Program*  
*Department of Neurosurgery*  
*University of Cincinnati College of Medicine*  
*Cincinnati, Ohio, USA*  
*kerry.crone@uc.edu*

---

---

---

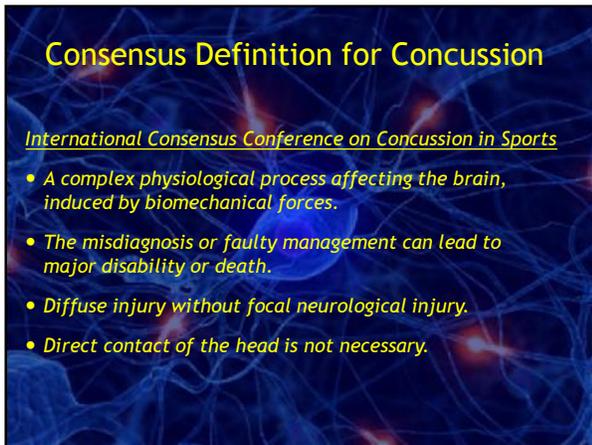
---

---

---

---

---



## Consensus Definition for Concussion

*International Consensus Conference on Concussion in Sports*

- A complex physiological process affecting the brain, induced by biomechanical forces.*
- The misdiagnosis or faulty management can lead to major disability or death.*
- Diffuse injury without focal neurological injury.*
- Direct contact of the head is not necessary.*

---

---

---

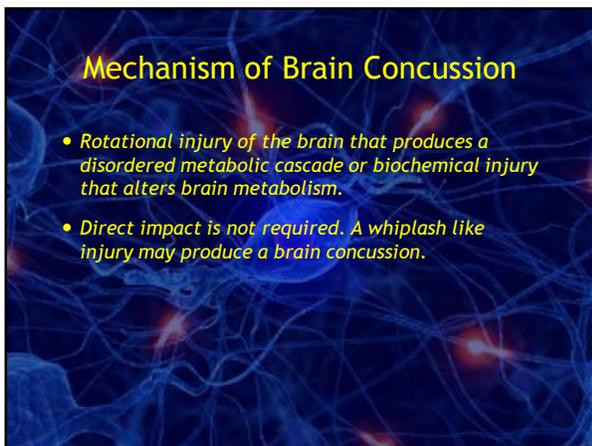
---

---

---

---

---



## Mechanism of Brain Concussion

- Rotational injury of the brain that produces a disordered metabolic cascade or biochemical injury that alters brain metabolism.*
- Direct impact is not required. A whiplash like injury may produce a brain concussion.*

---

---

---

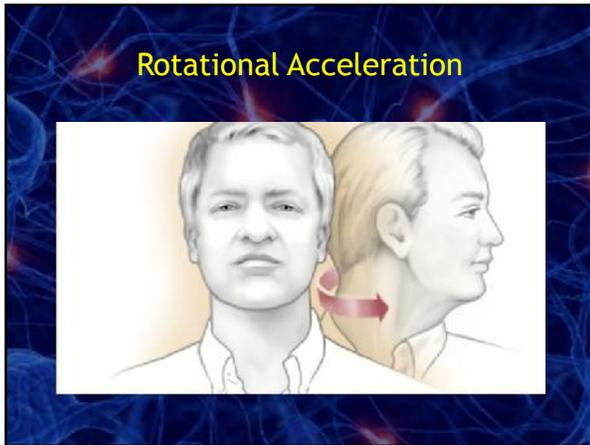
---

---

---

---

---



---

---

---

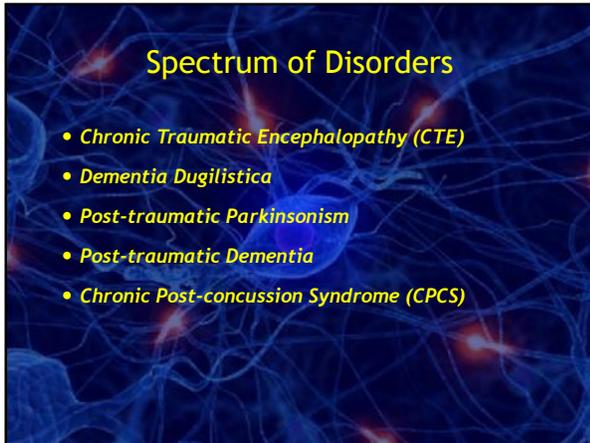
---

---

---

---

---



---

---

---

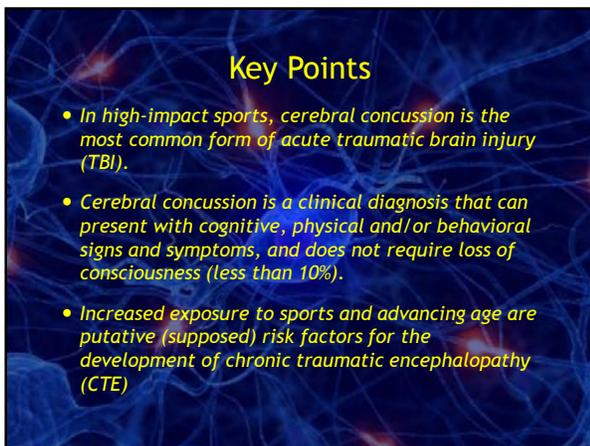
---

---

---

---

---



---

---

---

---

---

---

---

---

### Incidence

*Sport-related traumatic brain injury (TBI) is an important public health concern and is often labeled as a 'silent epidemic'. Estimates suggest that 1.6-3.8 million sport-related TBIs occur annually in the USA alone, and this number includes injuries for which no medical care is sought.*



---

---

---

---

---

---

---

---

### Facts

- *The young brain is more susceptible to concussion.*
- *Females are at greater risk than males.*
- *Possibly a genetic factor increases susceptibility to concussion*

---

---

---

---

---

---

---

---

### Signs and Symptoms

- *Confusion*
- *Emotional Liability*
- *Headache*
- *Dizziness*
- *Amnesia*

---

---

---

---

---

---

---

---

### Post-concussive Syndrome

- *Persistent, recurrent headache*
- *Dizziness*
- *Memory Impairment*
- *Unsteadiness*
- *Sensitivity to light and sound*
- *Concentration/Attention problems*
- *Anxiety/Depression*

---

---

---

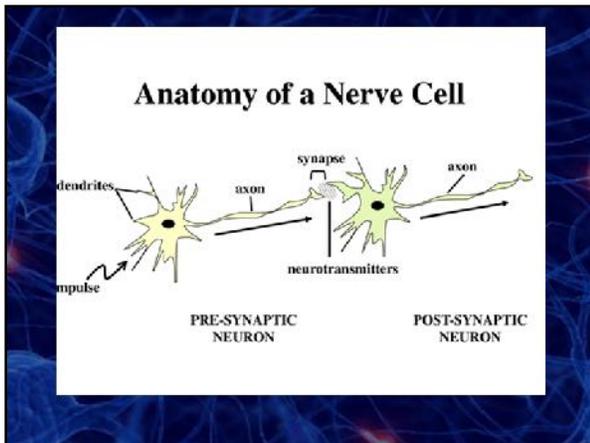
---

---

---

---

---



---

---

---

---

---

---

---

---

### Proposed Mechanism in Concussion

- *Injury produces unchecked neurotransmitter release and ions flux across the axonal membrane.*
- *Acute efflux of potassium causes the nerve cell to fire.*
- *The nerve cell attempts to restore the "normal" distribution of chemicals inside and outside of the cell, but an increased amount of energy is required secondary to the process (injury) that caused the nerve cell to fire.*
- *Additional nutrients are needed in this situation but blood flow is reduced to the brain.*

---

---

---

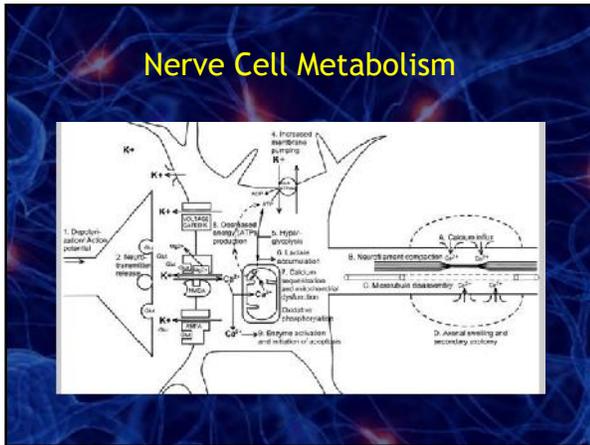
---

---

---

---

---



---

---

---

---

---

---

---

---

### Brain Vulnerability

- Following a concussion the brain is more vulnerable to a second injury. Animal models suggest at least 5 hours are needed for recovery.
- Therefore the rest period that is used to frame post-concussive management incorporates the time that is considered necessary for restorative function.
- Longer periods of time maybe needed for restoration of cognitive function.

---

---

---

---

---

---

---

---

### Subconcussive Injury

- Subconcussion is a cranial injury that does not result in known or diagnosed concussion on clinical grounds.
- Greatest effect through repetitive occurrences whereby cumulative exposure becomes deleterious.
- Evidence
  - Biophysics data
  - Advanced neuroimaging
  - Forensic analysis of brains of former football players

---

---

---

---

---

---

---

---



---

---

---

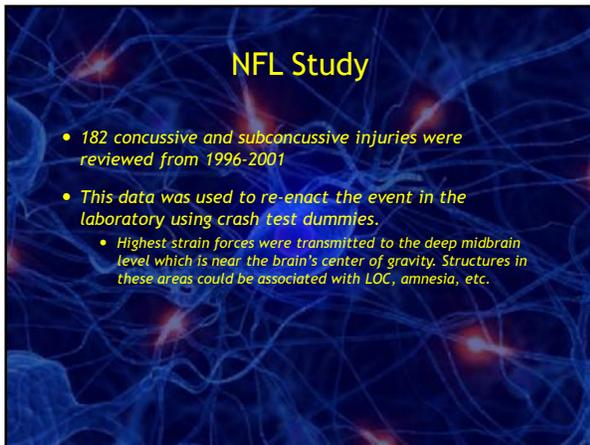
---

---

---

---

---



---

---

---

---

---

---

---

---



---

---

---

---

---

---

---

---



### Conclusion

- *Cerebral concussion represents a significant challenge in determining potential damaging effects to the brain*
- *Concussions are seen following motor vehicle accidents, sports injuries, and falls.*
- *The mechanism of brain injury associated with single or multiple concussions is unclear.*

---

---

---

---

---

---

---

---