Kinetic forces and brain injury, Google AI-overview, July 30th, 2025

Kinetic forces, such as those experienced during impacts or sudden movements, can cause traumatic brain injury (TBI) by directly damaging brain tissue or triggering secondary injury processes.
These forces can lead to both *focal injuries*, like contusions, and *diffuse injuries*, like *diffuse axonal injury (DAI)*, which involve widespread damage to nerve fibers.

Recognizing the biomechanics of TBI can help in developing better diagnostic tools and treatment strategies for various types of brain injuries.

How Kinetic Forces Cause Brain Injury

Direct Impact:
When the head experiences a sudden impact, the brain can move inside the skull, colliding with the bony structure and causing direct damage.

Acceleration/Deceleration:
Rapid acceleration and deceleration, even without direct impact, can cause the brain to shift and shear against the skull, leading to DAI and other injuries.

Rotational Forces:
Rotational acceleration, which occurs when the head twists or rotates, is particularly damaging to deep white matter tracts and can cause DAI.

Energy Transfer:
The amount of energy transferred to the brain during an impact is a critical factor in determining the severity of the injury. Higher energy transfer leads to more extensive damage.

Types of Brain Injuries Caused by Kinetic Forces

Focal Injuries:
These are localized injuries, such as contusions (bruising of the brain tissue) and hematomas (blood clots) that occur at the site of impact or its opposite side.

Diffuse Injuries:
These injuries affect a wider area of the brain, including DAI, which is characterized by widespread damage to nerve fibers.

Specific Examples

Concussion:
Often caused by rotational forces, concussions involve temporary disruptions in brain function.

DAI:
A severe form of TBI, DAI involves widespread damage to axons (nerve fibers) due to shearing forces within the brain.

Blast Injuries:
Explosions generate pressure waves that can cause widespread brain damage, including both focal and diffuse injuries.

Some sources used by Google for this article

www.ncbi.nlm.nih.gov/books/NBK326722/ Also on Diffuse Axonal Injury
www.frontiersin.org/journals/neurology/articles/10.3389/fneur.2015.00089/full Also on Blast Injury
https://pmc.ncbi.nlm.nih.gov/articles/PMC9351374/ Also on Rotational Head Acceleration
www.visitcompletecare.com/blog/what-happens-after-loss-of-consciousness-due-to-head-injury/
www.aans.org/patients/conditions-treatments/traumatic-brain-injury/