Example of causes of possible traumatic brain injury in a plane crash
Forces on and rotations of the body

Source: Undiagnosed Air Crash Brain Injury in Asiana Flight 214
http://aircrashbraininjury.com/

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To try to simplify a complicated engineering analysis, a brain can be injured by the application of force in a straightline, called linear force. This could potentially happen if you walked into a wall in the dark. However, the brain is far more vulnerable to injury if the straightline deceleration is combined with rotational force (meaning force where there is rotation of the head and neck). In a classic whiplash injury, the brain is most exposed because the head rotates in an arc around the waist, which is held in place by the seatbelt. That is the primary mechanism of injury when the head is not struck and one car rear-ends another. However, when a car wreck involves cars moving not in the same line, but in opposing angles (such as in an intersection collision) the rotational force can grow exponentially.

In Asiana 214 *[plane crash at San Francisco airport, July 6, 2013]* , these biomechanical issues combined to create severe risk of brain injury:

1. Deceleration of the plane suddenly from the 122 mph crash speed to zero, in a short distance on the runway;
2. A bouncing or wrenching type of force to the body, from the direct impact with the seawall, which would be transferred to a human body through the frame of the aircraft;
3. Rotational forces as the plane first yawed to the left and then rotated the other direction through an entire 360 degree of spin;
4. Additional dramatically increased force for any head/brain which hit either a part of the plane or another passenger, with head to head contact being amongst the most severe.
5. A direct blow to the head from flying debris or luggage. As the overhead luggage racks were shattered and debris was strewn throughout the plane so that there was no walking pathway for first responders.
6. The seat's collapsing on the plane, adding to the unanchored debris and potentially eliminating the safety effect of the seatbelt.

Each of the above forces is considerably more severe to the actual brain than it would be to any other part of the body, because the head and brain are the parts of the body furthest from the center of rotation, the seatbelt. The next most vulnerable point of injury in the body is the neck, as it is the part of the body which the head has to rotate upon.

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