Three Collisions in a Crash

Motor vehicle crashes involve three collisions and a thorough understanding of these allows occupants to lessen their risk of death or injury in the event of a crash. The only reasonable response to this understanding would be to properly wear seat belts and insure children are properly secured in child seats. For the purposes of this narrative, we will assume a very deadly, and all too familiar, crash in which the vehicle leaves the roadway and strikes an object.

A basic understanding of kinetic energy is needed to fully comprehend the three collisions involved in a crash. Kinetic energy is energy in motion. As a vehicle travels down the road it has a measurable amount of energy based upon its mass and velocity. If that vehicle leaves the road and strikes an object, the crash isn’t over until all the energy is used up. It doesn’t simply disappear. The energy is primarily spent on crushing, sound, and heat.

The first collision is the *vehicle collision*. Upon impact, the vehicle will begin to decelerate as it crushes due to the collision forces. Vehicles are designed to crush as a means of using up the energy in a crash. The more the vehicle crushes, as long as the occupant area is not intruded, the better the chances of survival. The vehicle shown left was driven into a house. The front of the vehicle began to crush upon impact allowing the energy to be used, however, the unbelted driver was killed due to the next two collisions.

The second collision is the *human collision*. In the human collision, the body continues going the same direction it was traveling prior to impact at the same relative speed. In our example of the vehicle striking a tree, the occupants of the vehicle will continue moving until they strike an object. The unrestrained occupants will strike the interior of the vehicle, such as the windshield, another occupant, or be ejected from the vehicle. Upon impact, the unrestrained occupant will come to a stop in a few hundredths of a second with only the human body to absorb the force of the crash. During the crash pictured to the right, the unbelted driver struck the steering wheel causing the deformation as his rib cage wrapped around the wheel. Upon impact, an unrestrained rear passenger continued forward striking the driver’s seat causing more force upon the driver. The driver was killed instantly.
Restrained occupants will strike the seat belt or harness of a child restraint. Though most seat belts have a breaking strength of 6,000 lbs, they can stretch as an occupant loads the seat belt during a crash. This allows the occupant to ‘ride down’ the crash forces. Pictured right is a seat belt that was loaded by an occupant during a crash.

The third collision is the internal collision. In the internal collision the human organs continue traveling until they strike other organs, bone, or the skull. Even though the body may appear uninjured, the liver, spleen, or heart may be torn, bruised, and/or bleeding. Closed head injuries can occur when the soft tissue of the brain strikes the skull or is torn as the skull fractures. Injuries sustained during the internal collision can be the most severe. At right is an example of brain injury sustained to an unrestrained occupant. Once the head struck an object, the brain continued in the direction of the force and struck the skull.

Restrained occupants will load the seat belt or harness of a child restraint system. As the human body ‘rides down’ the crash forces, so do the internal organs. Restrained occupants have a lesser chance of significant injuries during the internal collision.

It is important to note that each of these collisions can repeat themselves in some crashes. For example, a vehicle leaves the road and strikes a tree. Upon impact, the vehicle rotates and strikes another tree. In this scenario, each collision would have repeated itself at least twice. Rollover crashes pose an even greater risk as the collisions can repeat themselves and unbelted occupants also face the threat of ejection.

So how do seat belts help? Though simple in design, seat belts perform a number of tasks that can lessen injuries, prevent death, and keep drivers in control of the vehicle. First, seat belts keep you in the vehicle. If ejected, your risk of death is five times greater. Second, they keep occupants from striking objects in the car, such as the dashboard or windshield, and from striking each other. Third, seat belts allow the occupants to ‘ride down’ the forces involved in a crash and spread those forces across the stronger parts of the upper body. Instead of the occupant coming to a quick stop by striking the vehicle, the seat belt can stretch under the load increasing the time the occupant comes to a stop. The longer an occupant rides out the crash forces, the safer they will be. A belted driver can also remain in the proper position; behind the steering wheel in control of the vehicle.
How do airbags help? Airbags are a supplement to the most important part of the occupant restraint system, the seat belts. Seat belts are great at keeping an occupant from striking the interior of the vehicle, but the neck and spine can be injured from whiplash. Frontal airbags are primarily designed to stop the inertia of the head while the seat belt restrains the body. In combination, seat belts and airbags lessen the risk of injury to the neck and spine while causing less stress to the collarbone and shoulder.

In recent years, the focus on occupant safety from car manufacturers has included a major push to increase safety in side impact crashes. Beefed up doors, door frames, and stronger roofs have been introduced along with additional side and curtain airbags. However, all these safety improvements still require one simple device- the seat belt.