Q&A: Road Crashes and Trauma to the Human Body

The Question:
What happens to the human body in a car crash?
This Q&A has been produced to make drivers aware of why serious injuries occur in what can seem to be a simple prang.

Scope of the problem:
Next time you are sitting in the driver’s seat, take a look around the car. What do you see? The steering wheel, the dashboard, the windshield, the side pillars?

Imagine you are driving along at 30km/hr or 40km/hr. This generally seems slow in a car travelling along a straight section of road, but this is about the same speed you are travelling when you are going flat-out on a bicycle. Now imagine the windshield, the dashboard and the steering wheel are colliding with your head and torso at that speed. This is what drivers and front seat passengers experience in a collision.

People who are injured in road crashes often end up in hospital. Some require lengthy rehabilitation, some don’t recover, and many don’t survive.

Wearing a seatbelt is the most effective way to reduce the risk of injury in a road crash. Airbags also reduce injury risk during a crash. The combination of seatbelt and airbag is most effective.

Remember, most crashes can be avoided simply by driving safely and courteously.

According to the Traffic Accident Commission, in the past 12 months there have been 186 road fatalities and 1,677 hospitalisation claims in Victoria involving either a driver or passenger inside a vehicle.

All crashes are different and many different factors can affect the severity of injuries received. Some of the most important are:

- The type of crash
- The speed you are driving at
- Whether or not you have airbags
- Whether you are wearing a seatbelt
- Whether you are the passenger or the driver
- Whether you hit a stationary object or a moving object
- Whether an item in the car has become a projectile
- And many more.
Most common crash types

The 5 most frequent crashes in Australia are as follows:

1. Rear-Ending
   The most common crash in Australia, this is why tailgating is such a large issue.

2. Side-on Crash
   Otherwise known as getting t-boned.

3. Head-on
   To cars collide head to head.

4. Running off the road on a straight stretch
   Tiredness and distraction are major contributory factors and this type of crash can also often occur when drivers swerve to miss something on the road. Unfortunately, you can encounter a range of immovable objects in this kind of crash – trees, electricity poles and more.

5. Running off the road on a curve
   This is usually caused by going too fast, although being tired or getting distracted can also be factors. As above, in this case you can also run into several immovable objects.

6. Fatigue
   Fatigue results in a slower reaction time, shorter attention span, less effective memory, and less effective reasoning and decision making.
   For more information see the NRSPP’s Q&A on Fatigue.
The effect of speed and why

The direct cause of a physical injury is kinetic energy. The kinetic energy of a moving vehicle is a function of its mass and velocity squared and this energy must be absorbed in a collision by friction, heat, and the damage suffered by the vehicle as a result of the crash. This means, the more kinetic energy to be absorbed in a collision, the greater the potential for injury to vehicle occupants. Because kinetic energy is determined by the square of the vehicle's speed, rather than by speed alone, the probability of injury, and the severity of injuries that occur in a crash, rapidly becomes greater with vehicle speed. For example, a 30 per cent increase in speed (e.g., 80 to 105 km/h) results in a 69 per cent increase in the kinetic energy of a vehicle.

The speed you are driving at greatly influence your chance of survival in a car crash. The following graph depicts the survival rates of pedestrians in accidents, the survival rates of vehicle occupants in side impact crashes and the survival rates of vehicle occupants in frontal impact crashes at varying impact speeds. The risk percentage on the vertical axis is a representation of the risk of fatality. For more information see the NRSPP’s Quick Fact: why speed matters.

The faster you are travelling the higher your risk of fatality. A car travelling at 65 km/h will have a force of about 87 tonnes to be absorbed in a crash compared to a force of 74 tonnes needed to be absorbed by the car travelling at 60 km/h. And as can be seen from the graph, this means that you have double the risk of a casualty crash if you are travelling at 65 km/h rather than 60 km/h. But, travelling 10 km on a clear stretch of road at 65 km/h, rather than 60 km/h, will only save you 46 seconds.
**Most common injuries**

There are two broad categories of injuries caused by car accidents: (1) impact injuries, and (2) penetrating injuries. Impact injuries are typically caused when part of the person’s body hits some part of the interior of the car. Often this can be a knee hitting a dashboard or the head hitting the seat rest or the side window. Penetrating injuries are typically cuts and scrapes. Shattering glass or loose objects flying inside the car on impact often cause these types of injuries. The main injuries that can occur are soft tissue injuries, scrapes and cuts, head injuries, chest injuries, pelvis injuries and extremity (arm and leg) injuries.

Ninety-three percent of persons studied were seated in the front of the vehicle, with seatbelts claimed to be worn in 97% of cases.

When a hospital receives a major trauma patient they generally rated with an Injury Severity Score (ISS) of 15. The average ISS score of people in the study was 14.9, meaning most occupants were severely injured. With males generally injured more severely than females.

Head injuries were suffered by 39% of people in the study, with approximately half of these being severe injuries. Chest injuries were suffered by 66% of people, similarly approximately half of these were severe.

The results of this study are summarised in the table below.

<table>
<thead>
<tr>
<th>Injury Type</th>
<th>Single Impact Crash</th>
<th>Multiple Impact Crash</th>
<th>Rollover with Other Impact</th>
<th>Rollover with No Other Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td>14</td>
<td>21</td>
<td>24</td>
<td>38</td>
</tr>
<tr>
<td>Face</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Neck</td>
<td>2</td>
<td>4</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Chest</td>
<td>28</td>
<td>33</td>
<td>35</td>
<td>13</td>
</tr>
<tr>
<td>Abdomen/Pelvis</td>
<td>11</td>
<td>4</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Spine</td>
<td>4</td>
<td>8</td>
<td>16</td>
<td>12</td>
</tr>
<tr>
<td>Upper Extremities</td>
<td>8</td>
<td>17</td>
<td>14</td>
<td>13</td>
</tr>
<tr>
<td>Lower Extremities</td>
<td>18</td>
<td>21</td>
<td>22</td>
<td>12</td>
</tr>
</tbody>
</table>
Types of injuries per crash type

The following table shows the most common types of injuries caused in different accident scenarios.

<table>
<thead>
<tr>
<th>Type of crash</th>
<th>Injuries that commonly occur</th>
<th>Why these injuries occur</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head-on Crashes</td>
<td>Drivers and Passengers wearing seatbelts typically suffer chest and lower limb injuries. Those not wearing seatbelts often have severe head and facial injuries and more severe damage to their chest and lower extremities (this includes the pelvis, legs and feet).</td>
<td>The severely injured crash victim typically hits the steering wheel and dashboard. And injuries are far worse for those not wearing seatbelts.</td>
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<tr>
<td>Side-on Crashes</td>
<td>Side-on crashes can cause serious injuries at relatively low speeds. For people on the struck side of the vehicle, severe injuries are most commonly inflicted to the person’s chest, followed by the lower extremities, head and abdomen/pelvis.</td>
<td>On the struck side, severely injured people are most commonly hit by the door panel. For non-struck side occupants, severely injured people most commonly hit the driver or person next to them and then the “B pillar” on the rebound.</td>
</tr>
<tr>
<td>Rear-end Crashes</td>
<td>Severe injuries are most commonly suffered to the chest, head, neck and spine.</td>
<td>People are severely injured by the whiplash effect – whiplash is the result of the movement of the head forwards and then backwards very quickly.</td>
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<tr>
<td>Multiple impacts and rollovers</td>
<td>When a vehicle hits more than one other vehicle or object, or when it rolls over, the damage can be severe. Rollovers most commonly cause severe injuries to the upper extremities followed by the chest. Head and face injuries are also common. In multiple-impact crashes, the most severely injured people commonly have upper (hands, arms and shoulders) and lower extremity injuries, followed by chest, abdomen/pelvis, and head and face injuries.</td>
<td>In straight forward rollovers (not hitting anything else), people are most commonly injured by hitting the doors and the roof. People are also hurt when their body is ejected from the vehicle. In rollovers where the car hits something, people are commonly injured by the door, the floor, an object other than their car and the steering wheel. If you’re not wearing a seatbelt you will be tossed around inside the car. For multiple-impact crashes, severe injuries are most commonly caused by the person hitting the dashboard panel, followed by the door.</td>
</tr>
</tbody>
</table>
For more information

- Roads and Maritime Services
- Monash University Accident Research Centre
  http://www.monash.edu/muarc/research/research-areas/transport-safety/injury-analysis-and-data,
- Nolo
- TAC
- Roads and Traffic Authority of New South Wales