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THE FRONT END IMPACT COLLISIONS AND PEDESTRIAN RISK OF INJURY

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Improved crashworthiness and growing availability of systems to help drivers avoid crashes have made roads safer for vehicle occupants. Now engineers are working on improvements to vehicles that could protect pedestrians, too.

FRONT END COLLISIONS:

The consequence of such trauma depends on **various factors** as follows;

- Velocity of the subject vehicle - energy and velocity bears an exponential relationship.
- Velocity of the offending vehicle or object
- Resultant acceleration of the impact
- Restraints like seat belts or airbags – seat belt syndrome and air bag induced injuries.
- Reflex reaction of the driver or passengers of the subject vehicle like pushing arms towards the front seat by the rear end passenger out of panic or reflexive, deep breathing or breath holding resulting in hyperinflation of lungs making it prone to trauma.
- Structure of the front end of the colliding vehicle. **A 30 mph collision results in a 0.6m front end crush (13).**
- Size or mass of the vehicle involved. **It has been found that a collision between two small cars is worse than that between two large cars (1).**
- Position of the driver

- Characteristic of the injured tissue (old people whose bones have undergone degenerative changes sustain skeletal injuries like fractures in osteoporosis and young children with highly elastic tissue are less prone to fractures but more prone to muscle and soft tissue injuries).
- Windshield, steering column, dash board and rest of the car interior.

A new Institute analysis finds that a proposed regulation to modify the front of vehicles to lessen the harm they cause to pedestrians in crashes can help reduce deaths and injuries. The finding is important because few studies have examined the real-world effects of these vehicle design changes. At the same time, the Institute has been studying how pedestrian detection systems, which alert a driver of a person in the vehicle's path and in some cases brake automatically, perform on the test track.

One approach to the problem of pedestrian deaths and injuries is to modify the fronts of vehicles to make them "softer" if they contact a pedestrian. The idea stems from research dating to the 1970s, but its real-world application has taken hold only recently.

Crushable hoods and fenders cushion heads, and padding in bumper systems can mitigate leg injuries. Using plastic hood mounts and headlights that break away on impact also are intended to reduce chances that pedestrians will be injured. This is significant with rear impact car crashes as well. If we consider that many manufacturers create rear bumper systems that can withstand impacts of 12 mph and yield little to no property damage, is misleading.

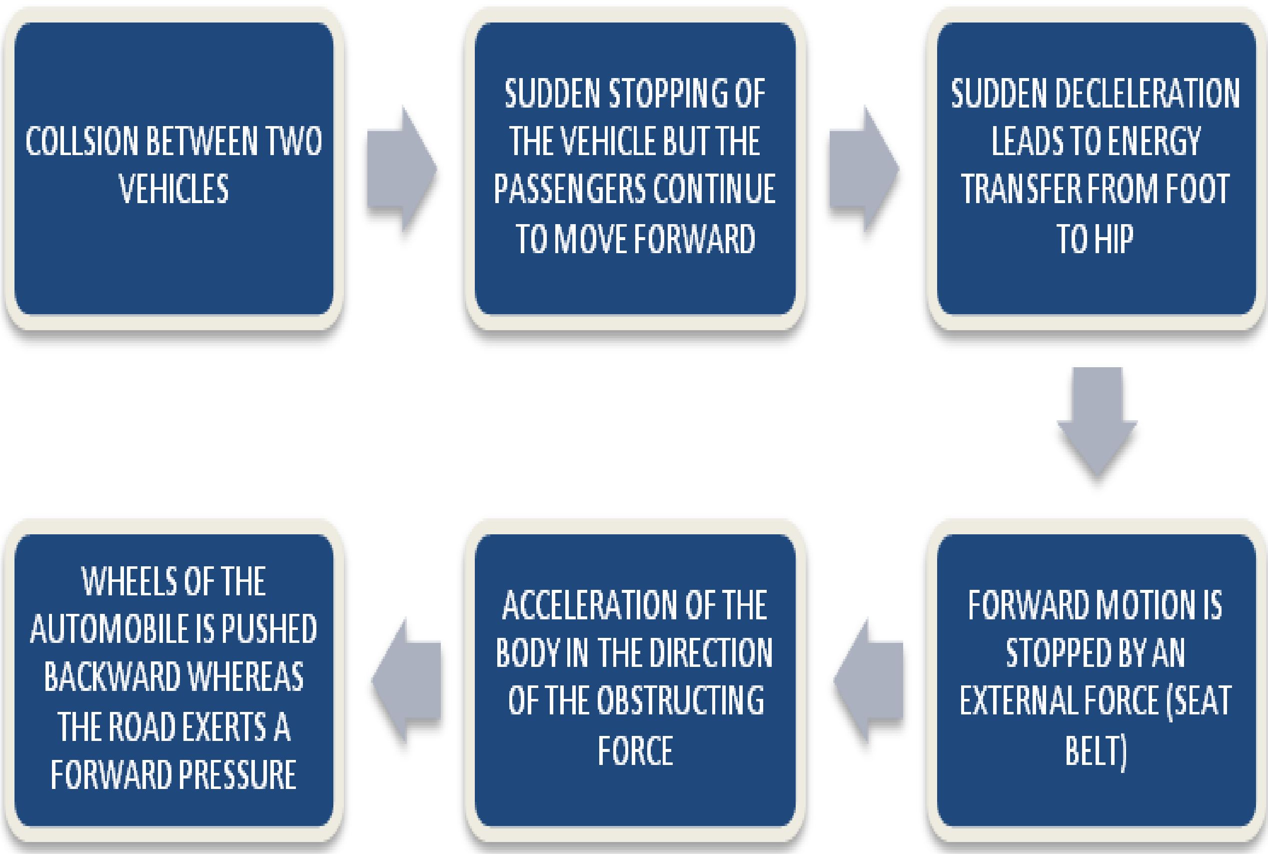
In the U.S., the National Highway Traffic Safety Administration (NHTSA) has been considering a global technical regulation since 2009 that would require tests to address pedestrian head-to-hood impacts for adults and children. The regulation known as GTR 9 is part of a United Nations' effort to harmonize certain vehicle safety standards worldwide. GTR 9 would require head impact tests for vehicle hoods but not the windshield and windshield pillar tests European regulators mandate. GTR 9 also addresses pedestrian leg-to-bumper impacts.

A 2012 IIHS study compared patterns of injuries sustained by pedestrians treated at a Washington, D.C.-area trauma center with the parts of the vehicle that would be affected by GTR 9 tests. Researchers found that the proposed regulation would address some but not all of the injuries seen in these real-world crashes.

In the latest IIHS pedestrian study, the goal was to compare the broader European tests and the narrower GTR 9 tests in terms of potential reductions in head injuries in U.S. crashes. Researchers conducted a series of head-impact tests on seven 2002-07 model small cars. They compared the predicted risk of injury from these tests to the real-world pedestrian injury and fatality rates for the same models based on data from police-reported pedestrian crashes in 14 states. None of the vehicles in the study were designed specifically for regulatory tests for pedestrian protection, although some models were associated with fewer serious injuries.

BIOMECHANICS OF A FRONTAL IMPACT

Understanding the mechanism behind a frontal impact requires a deep understanding of the laws of nature or the **physics of colliding objects**. Two colliding objects, in this case, the two automobiles seem to obey the three **Newtonian laws**.



- **About one-third of neck injuries are believed to be of frontal impact origin**. In A1S1 injury, **the response of the cervical muscles (trapezius) to the frontal impact was directly proportional to the level of acceleration (2).** Neck is the primary site of whiplash following low velocity frontal impacts. **Cervical muscle injury level is low in people who sat with trunk flexed during the impact (3).**
- **Pneumothorax-** reflex deep breathing is observed in victims who are caught by surprise during an impact. This hyper-inflates the lung making it prone to injury.

- When the anterior aspect of the neck strikes the steering column, it results in **laryngeal fracture and soft tissue injury**.
- Rotation of the ankle resulting in sprain and ligament tears following a knee impact.
- Head injuries result from head impacting the roof, windshield, mirror or dashboards. **Traumatic brain injury and post concussion symptoms** of varying severity are observed.
- Fractures of lower limb, when lower limb hits against the interiors of the car. **Nielson et al (1997) study, states that a delta v of 16 km/hr or higher is required to produce injuries in frontal impacts**.

Seat belts and airbags are not dependable when it comes to frontal impacts. **About half of the fatalities in frontal impact were belted individuals and among them 48 were the victims of small overlap impact and 23% were victims of a large overlap (6).** Seat belts have been a source of compression and hyper-flexion injuries. In **1962,** the term **seat belt syndrome (11, 12)** came into existence. It was characterized by abdominal wall ecchymosis, internal abdominal injuries, spinal fractures and clavicular fractures. Airbags studies revealed occurrence of **corneal abrasion, eyelid laceration and eye lens dislocation. Skin burns and eye burns** were observed in cases injured by the release of chemicals and heat during airbag deployment.

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