



## Low Speed Impacts Quantifying the Forces



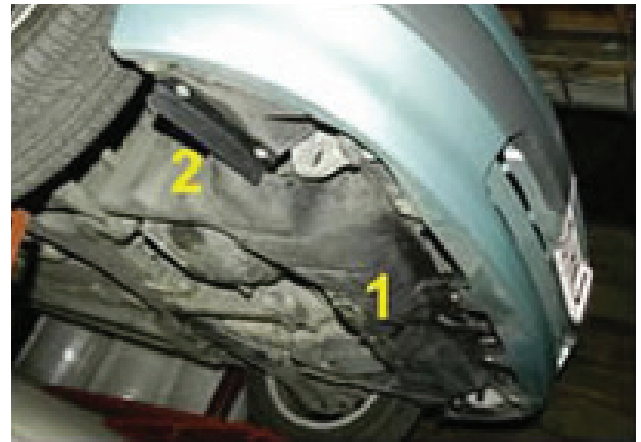
**Crashteam's collision reconstruction experts are often called upon to assess the forces involved in collisions where there is little visible damage to the involved vehicles.**

The reason we are assigned to these cases is simply that there is a suspicion that there was insufficient force in the collision to generate the injury causing mechanism. Normally the orientation of the collision is a same direction rear ender. Normally, the party advancing a claim for injury is in the struck vehicle. The technical process of determining the magnitude of the collision involves inspection of the involved vehicles. We inspect the bumper surfaces for signs of permanent deformation. We inspect, if the vehicles are so equipped, the bumper isolators for signs of sudden compression.

Many times, the involved vehicles have an impact absorbing rear bumper system. This is a polystyrene filled, polyurethane covered rear bumper. The rear bumper is supported by a steel reinforcing bar that is rigidly mounted by brackets to the unibody frame of the vehicle.

Research has shown that bumper isolators, which are fluid and gas filled shock absorbers designed to prevent vehicle damage from collisions with barriers or other vehicles, can set the threshold of visible vehicular damage at delta Vs (speed changes) ranging from 8.1 to 12.4 mph in modern cars. Yet below this threshold, the occupant can be exposed to significant acceleration pulses. The reported threshold for soft tissue injury of the neck in healthy adult males is a (vehicle) delta V of 5 mph. Therefore, modern passenger vehicles can crash at nearly twice this injury threshold, yet appear undamaged. Similar effects are seen in cars equipped with polystyrene and polyurethane impact absorbing bumpers. Lower speed collisions result in less plastic deformation of colliding vehicles. In these relatively elastic impacts, a greater proportion of force is directed to the occupants. There is no scientific evidence that these bumper designs have reduced injury to occupants.

It is possible for the bumper surface on the striking or struck vehicle to reveal little signs of contact as it is designed to reassert itself and have minimal repair costs on impacts of 5 mph and less. The SAE technical paper entitled "Automobile Bumper Behaviour in Low Speed



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Impacts” reported on impact testing which indicated vehicles with the polystyrene filled, polyurethane covered rear bumpers, would sustain impact speed changes up to 13.7 kph without any sign of permanent deformation. On the other hand, poorly designed bumper systems can allow thousands of dollars in damage to occur at speeds less than the generally accepted injury causing threshold.

The problem is now that the involved vehicles may have undergone impacts of a magnitude greater than the injury causing threshold. Impact testing with human volunteers done in British Columbia has shown that the first signs or symptoms of a neck injury begin to appear at a collision magnitude of 6.5 kph (speed change).



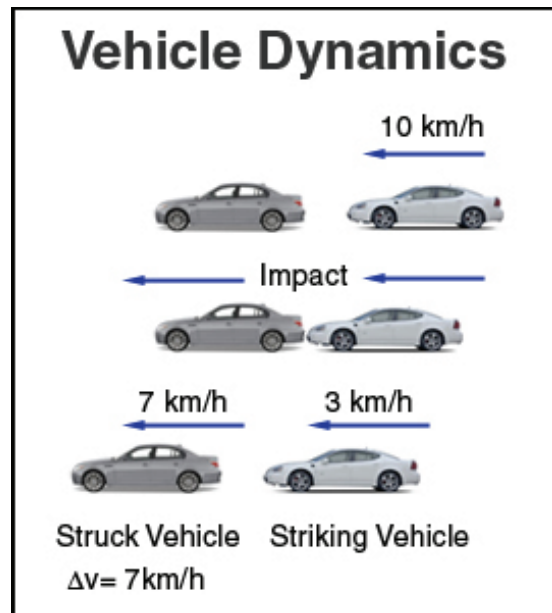
An SAE paper entitled “Analysis of Human Test Subjects Kinematic Responses to Low Velocity Rear Impacts” by McConnell indicates that even before the neck is hyperextended, the injury mechanism begins to occur. This means before the head accelerates any great distance rearwards to the point where the rearward excursion is limited by the positioning of the head rest, the injury has already begun. However, the injury mechanism does not stop there.

For example, if we were to assume the struck vehicle did sustain a speed change of 14 kph, this would generate 2.6 – 4 g of acceleration. This is based on an impulse duration of 100 – 150 milliseconds. The vehicle would be projected several feet forward and the consequence for the occupant is his body would accelerate at the same rate as the vehicle in the places where his body is supported by the vehicle seat. In this case, his neck would act as a lever and create a higher rate of acceleration for his head, because it is not supported. It has been reported the relationship between the head acceleration and the vehicle acceleration is 2.5:1. This means the acceleration forces would be 6.5 – 9 g., acting at his head.

In summary, the issue of whether or not the impact forces were sufficient to generate a neck or back injury is difficult to assess when the involved vehicles are equipped with modern bumper protection systems.

## What can Crashteam's experts do for you?

We can examine the available material on a preliminary basis to determine if the available data is sufficient for one of our experts to generate a quantitative analysis, answering the primary question of “were the forces sufficient to generate an injury”. For this process, we will not charge you a fee.



## REFERENCES:

“Repeated Low Speed Impacts with Utility Vehicles and Humans,” G.P. Neilson, G.P. Gough, Little, West and Baker, Accident Reconstruction Journal, Volume 8, #5, September/October 1996.

“Data and Methods for Estimating the Severity of Minor Impacts,” Bailey et al, SAE950352

“Clinical Response of Human Subjects to Rear-End Automobile Collisions” J. Brault, Wheeler, Gunter, Brault Arch Phys Med. Rehab Vol. 79, Jan 1998

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