

Delta-V, Spinal Trauma, and the Myth of the Minimal Damage Accident

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FROM ABSTRACT

The engineering mechanics of a car to car collision is rigorously analyzed for the case when there is little or no crush damage to either vehicle.

A general method is developed and presented for determining the changes in velocity (delta-v's) of the vehicles as well as the impact speed of the striking, or bullet, vehicle.

General results are presented along with specific results obtained in conjunction with a rigorous and proper interpretation of the delta-v's given by the damage algorithm contained in the EDCRASH computer program.

The advantage of using EDCRASH lies in the fact that delta-v results for a specific car to car collision are then easily obtained.

The results rigorously show that in a no damage accident the struck, or target vehicle can obtain a delta-v of 10 MPH or greater, which is well into an injury producing range. **[IMPORTANT]**

Furthermore, the paper scientifically dispels the myth that a minimal or no damage vehicle to vehicle collision implies that the delta-v of the target vehicle has to be 5 MPH or less. **[IMPORTANT]**

THESE AUTHORS ALSO NOTE:

The literature that refutes whiplash injury in low speed accidents is "scientifically and methodologically flawed which renders many of the literature conclusions invalid."

"Many authors, researchers and testifying experts in the fields of accident reconstruction and biomechanics utilize the concept of delta-v to assess the injury producing potential of a crash."

"Delta-v is the change in velocity that a vehicle undergoes in an accident, and is intimately related to the vehicle accelerations (decelerations) in a crash."

"However, in low to moderate delta-v accidents, with zero or minimal crush damage to the vehicles, delta-v is often erroneously calculated. An incorrect determination of delta-v can then ultimately affect an opinion on injury causation."

These authors present a method to determine vehicle delta-v's and the impact speed of the striking vehicle in car to car collision where there is little or no vehicle crush damage.

Although the authors use the well-known EDCRASH computer program, they caution that the EDCRASH program is flawed in zero or minimal crush damage collisions, and a "100% error in the vehicle delta-v's can occur."

Their analysis shows that the vehicle delta in zero or minimal crush damage collisions can be 10 MPH or greater, "which is well into an injury producing range."

"The analysis emphasizes that in low speed accidents, which are essentially elastic in nature with little or no energy dissipated by crush, neglecting the vehicle restitution phase of the collision results in serious underestimates to the vehicle delta-v and the injury producing potential of the accident."

These authors "dispel the myth that a minimal or no damage vehicle to vehicle collision implies that the delta-v of the target vehicle has to be 5 MPH or less."

"This is a totally incorrect assertion sometimes promulgated by accident reconstruction and biomechanics experts who are unfamiliar with the proper analysis of a zero damage, elastic collision where energy is conserved and no permanent crush occurs."

The authors review the actual collisions of a 3500 pound bullet vehicle impacting the rear bumper of a stationary 2500 pound target vehicle in two different tests. In the first test, the impact speed of the bullet vehicle is 4 MPH and 9 MPH, resulting in a delta-v of the target vehicle of 5 MPH and 11 MPH.

In both tests there was no permanent damage to the bumper system of either vehicle, i.e., "the collisions were elastic and are representative of vehicle responses in a zero or minimal damage accident."

The authors note that an elastic collision means that there is no permanent damage sustained by either vehicle although the bumper systems do compress and then rebound during the restitution phase. **[IMPORTANT]**

The authors note that there are 3 major flaws in the EDCRASH computer program, the most serious being the delta-v's derived are not the total delta-v's of the vehicle in the crash because EDCRASH does not consider the elastic rebound phase of the vehicles that follows bumper deformation.

This oversight is critical in evaluating the delta-v's of zero or minimal crush damage collisions.

The authors use a lot of math and examples to show that actual delta-v's from zero or minimal crush damage collisions are typically double those calculated by the EDCRASH program.

This often puts these zero or minimal crush damage collisions into the injury producing range.

The authors "emphasize that neglecting the elasticity of the bumper systems and the restitution phase of the crash will result in a very serious underestimation of delta-v" of the struck vehicle "in a low speed collision."

"If a reconstructionist or biomechanician accepted the EDCRASH results for delta-v a 100% error will occur."

"It is critical in the analysis of low to moderate delta-v accidents to include the elastic restitution phase of the crash in order to properly calculate the total vehicle delta-v's."

The authors note that depending on the weight ratio of the vehicles and the bumper design, in a no damage collision, the struck vehicle's delta-v's "can be in excess of 10 MPH without any permanent crush damage to either vehicle."

"It is totally incorrect, and a myth, if a reconstructionist or biomechanician concludes that no damage means that the delta-v must be less than 5 MPH. This point, which is extremely important..."

The authors also note that "a vehicle inspection would be necessary to determine if the bumper pistons of the bullet vehicle were stroked or if any other energy absorbing material, such as structural foam or honeycomb structures, indicated compression damage."

Also, "the rear bumper structural and energy absorbing systems would have to be inspected to determine if they were compressed and/or permanently deformed."

"During vehicle inspections, careful crush measurements would be made and compared to the original dimensions of the vehicle."

The authors note that if there is permanent crush damage, it "cannot be determined from an examination of vehicle photographs."

KEY POINTS FROM DAN MURPHY

- (1) The apparent standard used to assess the injury producing potential of a crash is the concept of delta-v.
- (2) The delta-v is often assessed by using the EDCRASH computer system.
- (3) However, the EDCRASH program is flawed in zero or minimal crush damage collisions.
- (4) Specifically, the well-known EDCRASH computer program can underestimate the delta-v by 100%, meaning that the actual delta v was twice that assessed by the computer program.
- (5) This underestimate of the actual delta-v means that the delta-v is often well into an injury producing range, even though it was a zero or minimal crush damage collision.
- (6) The vehicle delta-v in zero or minimal crush damage collisions can be 10 MPH or greater, which is well into an injury producing range.
- (7) The basic flaw in the EDCRASH assessment is that zero or minimal crush damage collisions are elastic (meaning no damage to either vehicle) resulting in little or no energy dissipated by crush, even though the bumper systems do compress and then rebound during the restitution phase.
- (8) Neglecting the elasticity of the bumper systems results in a very serious underestimation of delta-v of the struck vehicle in a low speed collision.
- (9) Many accident reconstruction and biomechanics experts are unfamiliar with the proper analysis of a zero damage elastic collision where energy is conserved and no permanent crush occurs.
- (10) Vehicle damage cannot be properly assessed by looking at vehicle photographs, but requires careful vehicle inspections and measurements.
- (11) Literature that proclaims that one cannot sustain whiplash injury in low speed accidents is scientifically and methodologically flawed and invalid.