C4 Understanding Injury Potential in Low Damage Automobile Collisions

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The goal of this presentation is to provide further insight into correlation between vehicle damage and impact severity.

Observation of body damage coupled with frame deformation may provide criteria by which to judge impact speeds in situations where a visual examination of the vehicle shows little or no damage. This presentation will impact the forensic community and/or humanity by describing impact speed thresholds, which can prove helpful in understanding the injury severity in what otherwise, might appear to be a very low speed impact.

INTRODUCTION: Raymond Smith and Associates is sometimes confronted by cases in which a vehicle has been impacted by another vehicle, resulting in little or no visible damage. The driver of the target vehicle has sustained some fairly serious injuries, as determined by their physicians. How can the significant occupant injuries be reconciled with the apparent lack of significant vehicle damage? An approach has been developed, which demonstrates that in a number of these cases, despite the absence of obvious visible vehicle damage, the frame (or unibody) of the target vehicle was deformed by the force of the collision.

A number of recent cases involve collisions in which a vehicle's driver or passenger sustained significant head, neck, and back injuries. A physician diagnosed the injuries. The vehicle inspection often showed little to no obvious visible damage. Sometimes the bumper cover was scuffed, or there was a slight indentation in the bumper cover. Detailed body shop repair estimates for the vehicles, when available, showed either no damage or a need to replace only the bumper cover.

A reconstruction expert claimed that because the damage level was so low, the bullet vehicle impact speed was under 5 m.p.h. and the speed change of the injured party's target vehicle was less than 3 m.p.h. Thus it was unlikely that they would have been injured.

THE APPROACH: When examining the target vehicle, the author looked at the fit of the hood, the trunk lid, and the doors. The eye can easily see a distortion of less than 1 millimeter in the fit of these items. If the spacing between these components and the vehicle's body appeared to be uneven, a precision frame measurement was recommended. In every one of 14 recent cases, where visual evidence of external body distortion was observed, the precision frame measurement verified that the frame or unibody had been deformed beyond factory specifications. The 14 cases shown in Table 1, involved different vehicles impacted from the front, the rear, and the sides.

In most of the cases where this method was applied, the frame or unibody distortion was approximately 1 centimeter. This is not necessarily sufficient to cause difficulty steering, or uneven tire wear. It is, however, indicative of a very forceful impact at a speed far above the 5 m.p.h. cited by the other expert.

If no evidence of frame distortion was observed, removal of the bumper cover and disassembly of the bumper system often revealed deformation of the underlying bumper structure. Following the collision, in several cases, the bumper cover popped back out to its pre-impact position, masking the damage.

Frame deformations of ~1 centimeter are indicative of impact speeds in the range 15 to 25 m.p.h. This speed range can be identified because, in a number of cases where frame distortion was observed, the impact speed could be independently determined based on post impact movement of the vehicles involved. Bumper damage generally does not appear in vehicleto-vehicle collisions below 8 to 10 m.p.h. Frame distortion is generally not seen below 12 to 15 m.p.h. At impact speeds in excess of 25 m.p.h. one would expect to see serious body damage to the vehicles.

The literature contains reports of numerical modeling efforts, which attempt to correlate the forces imposed on a vehicle, in a collision, with the expected deformation of the vehicle. At present, these models are still in their infancy, and are not capable of predicting the type of deformations, which are the subject of this paper. At some point it may be possible to determine the impact speed, which caused a particular frame deformation, using a finite element numerical modeling approach.

UNDERSTANDING INJURY POTENTIAL: The technical literature supports the view that there is no minimum or threshold vehicle impact speed (or speed change) required for occupant injury to occur. Logically, the higher the speed change, the greater the probability of injury. A portion of the impact energy is channeled into the vehicle's occupants. Injury to the occupants can occur as a result of the acceleration forces and from interaction between the occupant and the interior components of the vehicle, including the seat belt. Observation of body damage coupled with frame deformation may provide criteria by which to judge impact speeds in situations where a visual examination of the vehicle shows little or no damage. The impact speed vs. damage described can prove helpful in understanding the injury severity

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Table 1 FRAME/UNIBODY DEFORMATION CASE TABULATION

IMPACTED VEHICLE	IMPACT LOCATION	IMPACT SPEED (mph)	REPAIR $	DEFORMATION (mm)	INJURY
1992 Nissan Maxima	Left Side, L.F. Tire	25-35 Tire Involvement	4691	4	Lumbar, required spinal fusion
1995 Honda Accord	Left Front End	25-35 Tire Involvement	6805	6	No data
1997 Ford F150 PU	Right Rear	37-40	1954	7	Ruptured L5-S1
1994 Dodge Ram 1500 PU	Rear	15-25	3367	14	Herniation L5-S1
1992 Buick Le Sabre	Rear	>25	736	32	Stenosis at L3/4 , L4/5 and L5/S1
2000 Ford E250 Van	Front & Rear	Moderate	3839	5	Brain injury
1995 Ford Explorer 2WD	Rear	20-35	4031	18	Herniation L4/5 and L5/S1
1998 Toyota Corolla	Rear	15-25	422	6	Required spinal fusion
1992 Ford T.Bird	Rear End	20-25	5354	11	Herniated disk at L5
2002 Saab	Left side, front tire	20-35	-	38	Cracked teeth, back problems
1989 Ford Tempo	Rear	22	~500	11	Herniated disks C4-C5
1991 Chevrolet Blazer	Rear End**	20-35	2888	8	3 back surgeries: laminectomy, fusion
1998 GMC Suburban	Rear End	15-25	110	8	Closed head injury, cervical injuries
1999 Jeep Wrangler	Rear End	20-25	None	17	TMJ, Back injuries

Injury, Collision, Frame

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