D13 Who's Driving?

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After attending this presentation, attendees will understand how biomechanics can provide useful information that helps identify operators of motor vehicles involved in accidents.

This presentation will impact the forensic science community by raising awareness that motor vehicle operator identification is sometimes obscure and by illustrating how biomechanics can be used to reduce uncertainty in efforts to identify operators of motor vehicles involved in crashes.

Operator identification of a motor vehicle involved in an accident, while always imperative due to potential criminal and nearly ubiquitous civil consequences, is sometimes obscure due to event circumstances or operator intent to eschew culpability. Correct operator identification is also necessary to prevent wrongful incrimination of innocent passengers.

First responders may report unrestrained occupants in out-of-position interior vehicle locations or outside the vehicle following crash-induced ejection. Operator identification is obscured when such occupants are unable or unwilling to disclose the facts or when uninjured drivers flee the scene before first responders arrive. Forensic investigations seeking operator identification may benefit from the application of biomechanics to analyze the relationships between vehicle damage and human injury.

External vehicle collision analysis quantifies crash force vectors and energy magnitudes. It is an essential prerequisite for application of biomechanical principles seeking driver identification. The principle direction of force is a key parameter established by vehicle collision analysis that, in turn, enables useful information to be obtained from the "second collision" (i.e., occupant collision with the vehicle interior).

Direction of occupant motion is, in the event of a single crash event, parallel to the line of action of the principle direction of force. This line of action determines the trajectory of the body of the unrestrained occupant or the limbs of restrained occupants and the vehicle interior components struck. Information regarding occupant trajectory, considered with first responder-provided data, enables estimation of pre-crash occupant position. Vehicle rollovers and successive crash impacts confound this analysis due to multiple, and sometimes unknown, crash force lines of action. Position identification may also be confounded by occupant ejection due to uncertainties regarding vehicle angle at the time of ejection, escape velocity, and body trajectory.

Consideration of crash force magnitudes may also assist driver identification because these force magnitudes are often proportional to occupant injury severity. Crash force magnitudes may be passenger compartment-specific and are most helpful when considered from two complimentary perspectives: vehicle interior interactions with the human body and human body interactions with the vehicle interior. These interactions require information concerning the mechanical properties of the struck vehicle's interior elements and striking human body components. Quantification of interior component striking force magnitudes begins with peak values established by external collision analyses; these peak force magnitudes are subsequently mitigated due to intervening vehicle structures. Mechanical properties of vehicle components are typically constants with each vehicle design and are amenable to empirical verification. Mechanical properties of human limbs, organs, or tissues are highly variable and depend upon gender, age, genetics, etc. Analysis of the multiple relationships among crash force magnitudes, vehicle interior damage (magnitude, direction, and location), and reported (emergency services and hospital records) type and extent of injury to each vehicle occupant collectively provides data regarding occupant positions at the time of the crash.

Biomechanical analyses of organ damage due to intra-body cavity impact may also provide useful occupant-relevant data. Examples include aortic isthmus injury due to blunt chest impact, femoral head-induced acetabular wall fractures due to knee-dash impact, seat belt-related liver or spleen lacerations, and cranial contusions due to B-pillar impact. Unfortunately, quantitative biomechanical analyses of these injury types are frequently limited by insufficient knowledge of the constitutive mechanical properties of the affected organs and their individual variations with gender, age, genetics, etc. Difficulties performing such analyses are substantially increased when any of the occupants are infants or toddlers.

In conclusion, biomechanical analyses of human injuries relative to vehicle damage can be a useful tool in aiding forensic investigations seeking motor vehicle-operator identification.

Biomechanics, Motor Vehicle Crash, Driver Identification

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