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Biomechanics In Accident Analysis

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Biomechanics uses engineering principles and the laws of physics to describe the motions of a person, the forces they can apply and the forces and injuries to which they are subjected. As used in forensic analysis, the application of biomechanics ascertains how claimed injuries are related to claimed events.

Often an injury occurs involving a machine. The physician diagnoses and treats the injury. Most of the time he has only second or third hand knowledge of the *alleged* events that led up to the injury, and this is not his primary concern - treating the patient is. The physician does not have the opportunity to explore the environment in which the injury occurred. If an engineer is called in, he evaluates the operation of the machine. He answers questions such as: Did the controls function properly? Were the proper guards in place? Was it properly maintained?

However, there is a void that exists between where the engineer leaves off and the physician picks up. This is the void that is filled by a biomechanist.

A person with a biomechanical engineering background will frequently have the ability to inspect and understand the operation of the machine, review the technical drawings and be able to speak to the technicians and engineers on their level.

Additionally, a person with a biomechanical background will know what medical documents or tests to review, assimilate the results of the radiographs with the notes of the nurses and the reports from the ambulance crew and the emergency room. A considerable amount of information can be obtained by knowing the position in which the injured person was found, where the scrapes, lacerations and fractures occurred and what was found during surgery. Even the geometry of a broken bone can provide evidence as to how the injury occurred.

Most importantly, with the addition of statements, police reports and testimony, the biomechanist will be able to see the entire picture from a perspective that a mechanical engineer, electrical engineer or physician cannot.

An unfortunate situation that commonly occurs is two occupants in one vehicle that is involved in a single vehicle collision, such as a high speed rollover, resulting in the ejection of both occupants. There may be conflicting statements as to who was driving - or none at all.

Will the physician examine the vehicle and the accident location to determine how the vehicle rolled or what was damaged in the vehicle? Will the vehicle accident reconstructionist obtain the medical or autopsy records to match the abrasions and contusions to the damage found in the vehicle? Typically not.

A biomechanist is capable of seeing the whole picture from the vehicle dynamics involved to occupant injuries. This allows for a more complete and accurate understanding of the event and an answer to the question of who was driving.

In another example, a carpenter used a powered miter saw that had a guard around the blade. He claims he turned to his left, and his hand was severed at the wrist and dropped. Could this have really happened? Could the motion of looking to the left have positioned his hand in proximity to the blade? Additionally, the blade was guarded. Therefore, how could this have occurred as stated?

A biomechanical analysis examined how the man stated he was positioned prior to the incident. It took into account whether he was bending over or kneeling and where his hands were located. It was shown that turning at the waist would place his hand near the blade and guard, and the angle of contact matched the angle of amputation as shown in the x-ray film.

Researching the properties of bone for various animals and matching it to that for human bone allowed for dynamic testing to be conducted on animal bone in order to determine what happens when a limb contacts the guard that is covering the spinning saw blade. Slow motion video analysis showed that the animal bone, which was the approximate size of a human wrist, was severed in less time than an eye blink. Indeed, the accident did happen just as the carpenter claimed.

In another instance, a driver of a small truck was stopped at an intersection when an out of control tractor-trailer ran into the rear of his vehicle. His vehicle was pushed

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forward into several cars, whose occupants were also injured. The tractor-trailer driver was uninjured, but the driver of the small truck had chronic pain in his head, neck, back and legs. A review of the medical records and interview of the driver were conducted. He recalled not wearing a seat belt, being thrust forward, and then ultimately lying on the passenger seat. An examination of his truck showed a dented driver's sun visor, a dent in the metal on the inside of the passenger door, and a bent steel bar in the driver's side seat frame. This matched the expected dynamics of his body and supported his injury claim.

On the other hand, the driver of a trash hauling truck claimed he received neck injuries because of a modification to the chassis of the truck. According to the driver, he hit his head on the ceiling of the truck as he went over a bumpy road, and the front wheels of the truck came off the ground.

When weight equivalent to the truck driver's was applied to the seat, an analysis with an anatomically correct spine model clearly showed that the location of the bent seat frame corresponded exactly to the location of the spinal disc that was injured.

His claim was tested by re-enacting the events, using the same truck, on the same road with an exemplar driver. A video camera situated on the exterior of the truck recorded the motions of the front tire. Two other video cameras were mounted in the truck cab in order to record the motions of the seat and of the driver's head. At speeds below, above, and at the speed claimed by the injured party, the front tire never left the road, the seat suspension never topped out and the head of the exemplar driver never touched the ceiling. In fact, the same testing on an unmodified truck showed *greater* vertical movement of the driver - but the tires still never left the road. His claim proved to be unfounded.

A dump truck rolled onto its right side while the bed was being raised. The driver was found injured on the ground, to the right of the passenger side of the truck. How did this happen? Did he fall out of the driver's window, or maybe the passenger side window?

A woman working at a poultry processing plant received lacerations and partial amputations to her finger on her right hand. She claimed that the sleeve of the uniform that she was wearing became caught in the machine, pulling her hand in. An examination of the sleeve on the uniform she had been wearing showed no tears or creases. Inserting the sleeve of an exemplar uniform into the same machine resulted in damage to the fabric.

Examining the x-ray films and comparing the orientation of the severed bones to the orientation that the hand would be in if it was pulled into the machine showed that it could not have occurred the way she described. How did she receive her injuries?

For answers to these questions, and maybe to some of your own, please contact Mark Strauss at 800-355-7800 or at mgstrauss@ruhl.com.

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