Involving a Biomechanical Engineering Expert in Motor Vehicle Collision Cases

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Biomedical engineering involves the application of electrical, mechanical and chemical engineering principles to the human body, in essence combining engineering with medicine. Biomedical engineering experts, whether they are trained in electrical, mechanical or chemical engineering can bring clarity to complex cases involving injury or pain and suffering due to medical malpractice, product failure or malfunction, vehicular collision or a vast array of other situations.

A biomedical engineering expert should be engaged when the cause or mechanism of injury is unknown, not understood or in dispute, to show that the product did not meet industry standards and hence contributed to or caused injury and/or death. Early involvement of a biomedical engineering expert can help to preserve perishable evidence, and help identify defendants or other responsible parties. They can also assist in establishing an advantageous theme from the onset, including the identification of additional experts when necessary.

Biomechanics is the sub-specialty of biomedical engineering which focuses on the response of tissues (i.e., bones, brain, muscle, etc.) to internal and external loads or forces. Speed, energy and collisions commonly result in devastating injuries.

In parallel with the advent of the industrialized age and the first motorized vehicles, boats and aircraft, it was recognized that special means would be required to protect travelers and workers. Thus stimulating government, military and industry sponsored research in the fields of injury biomechanics. Due to both national and international endeavors, a wealth of information concerning injury thresholds and injury patterns in common events such as collisions, falls and occupational injuries are available for biomechanical engineering analyses.

A biomechanical expert analyzes tissue injuries, often matching the forces known to cause specific injury patterns to the injury event (or, vice versa, match forces in a specific event to documentable injury

thresholds). Areas of evaluation frequently include the head, brain, neck, back, spinal cord, vascular ruptures, abdominal organs such as heart, lungs and skin including burns and musculo-skeletal including joints (i.e., shoulders, knees, ankles and elbows), soft tissues (i.e., rotator cuff, tendons and ligaments), and fracture patterns (torso, long bone, hand , foot or skull). Your biomechanical engineering expert should have knowledge and training in the areas of anatomy and physiology.

Often, biomechanical experts perform investigations aimed at answering the following questions:

- **Were forces sufficient to have caused injury (i.e., whiplash, low back injury)?**
- **Would the occupant have survived had the restraint system properly functioned?**
- **Would an occupant's injuries be less severe had he/she been wearing his/her seatbelt?**
- **What was the position and orientation of the pedestrian when struck?**
- **Based upon the injuries, who was driving?**

A biomechanics expert properly analyzes the injuries related to vehicular collisions utilizing the scientific method. Relevant hypotheses are formulated based upon the issues in a given case, such as the rear-end collision generated sufficient force to cause or exacerbate the plaintiff's diagnosed L4-L6 postero-lateral disc herniation; had the airbag deployed, the plaintiff would not have struck her head causing her C7-T1 burst fracture; the forces necessary to cause plaintiff's diagnosed left sided pelvic fracture could only occur if the plaintiff were positioned in the front passenger seat during the collision.

The hypothesis or hypotheses are then tested against the available information in a case. Often, a biomechanical engineering expert will rely upon the reports of the first responders including police, EMS and fire department, medical records, diagnostic imaging (X-ray, CTs, MRIs) and radiological reports, witness statements, deposition testimony, photographs of the scene, vehicle damage and of the injuries. Using the medical records, a list of the diagnosed injuries is generated. Applying his/her expertise in tissue mechanics and the necessary medical/scientific literature, the mechanism of each injury, or collection of injuries, is identified.

An injury is a failure of a tissue or group of tissues. Tissues fail due to the loads that are applied to it. Forces or loads have magnitude (or size) and direction (tension, compression, flexion, torsion, etc.). Injuries can also occur because of the time or rate at which the load is applied. For instance, as you are traveling in your vehicle at 60 MPH you can apply the brakes and come to a stop (0 MPH). This deceleration (slowing down) may take 10 seconds and you are not injured. However, if you were to be traveling at 60 MPH and come to a stop (0 MPH) abruptly (0.1 seconds) by striking a brick wall, injury is likely to occur. In this example your overall change in speed is not different. Rather, the time over which that change in speed occurred is dramatically different. The rate or time over which the speed change occurred influences the likelihood of injury.

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After determining the mechanism of injury the biomechanical expert continues to test the hypotheses by determining forces (kinetics) and motions (kinematics) of the occupant or pedestrian during the collision. The determination of occupant kinematics and accident reconstruction is rooted in the fundamental and universally accepted Laws of Physics. A tremendous body of scientific literature exists documenting and measuring occupant kinematics during various types of collisions.

The forces and/or motions generated during a collision and experi-

enced by the occupant/pedestrian are then compared to the forces and/or motions (mechanism of injury) necessary to cause the claimed injuries. If the forces and/or motions generated are equivalent to those necessary to cause the injury then the hypothesis is confirmed, and a causal relation exists between the collision and the claimed injuries. While each case is different, with its own distinct set of facts and concerns, necessitating a unique perspective, the investigation conducted by a biomedical engineering expert will generally involve several steps. Initially the expert will review all of the case documents or materials. This may include accident reports by police, fire or emergency medical services, scene photos, emergency room records, X-rays, CT and MRI scans, medical records from treating physicians, operative reports and reports by physicians performing independent medical exams. If pre-existing medical conditions are suspected, medical records from previous treating physicians, chiropractors and physical therapists may contain important and relevant information. The expert will then review applicable medical and scientific literature. All relevant analyses are then conducted; this is dictated by the type of case and the purpose of the investigation.

In some situations, inspection and/or laboratory testing will be necessary. Inspection of the site, vehicle or product will provide the expert with the opportunity to measure, photograph and observe the site, vehicle or product. Sometimes laboratory testing can help quantifya parameter or hypothesis not otherwise available in the medical or scientific literature. Laboratory testing commonly requires a significant amount of time, careful planning and expense. Depending on the situation, standards will be used as a guide for developing the test design. In any situation, the testing must follow the scientific method and use accepted testing methods.

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Biomedical engineering experts provide a bridge between mechanical, electrical and chemical engineering and medicine. It is important to find and involve an expert early on that possesses the knowledge, training and experience most closely aligned with the issues involved in your case. Early involvement will ensure the proper analysis of the evidence in an efficient and effective manner, increasing the opportunity for a successful outcome for your case.

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