



**Consulting Engineers & Scientists, Inc.**

**THE EXPERT APPROACH  
TO  
FORENSIC BIOMECHANICS**

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## FORENSIC BIOMECHANICS

### INTRODUCTION

Biomechanics is the marriage of mechanical engineering with anatomy and physiology. Just as a mechanical engineer studies the structures, mechanisms, and materials of mechanical devices, the biomechanical engineer studies the structures, mechanisms, and materials that compose the human body. The broad range of biomechanical engineering research encompasses many subsets with different research objectives and interests. Sports biomechanics researchers focus their efforts on trying to improve the performance of athletes by developing better form and technique and by improving equipment. Orthopedic biomechanics researchers focus on the prevention, treatment, and rehabilitation of injuries and pathologies to the muscular skeletal system. Injury biomechanics focuses on how injuries occur and how they can be prevented by studying the mechanics of injuries and the human body's tolerance to injury. Occupational biomechanics focuses on setting guidelines and developing equipment to make workplace environments and tasks safer.

### FORENSIC BIOMECHANICS

Forensic biomechanics draws on research that is performed in all the areas of biomechanics listed above and many more to allow for the evaluation and reconstruction of accidents. Because forensic biomechanics focuses on the person and his interaction with his environment and with things in his environment, it is applicable to many areas of litigation. In premises liability cases, biomechanics is utilized to determine whether the mechanism of injury and the mechanics of the incident are consistent with the plaintiff's claims. In motor vehicle accidents, biomechanical engineers work alongside accident reconstructionists to determine the occupant dynamics and how injuries occur within a vehicle; to evaluate restraint systems and protective devices, and to determine if injuries are consistent with available evidence. In products liability cases, biomechanical engineers who are often mechanical engineers can not only evaluate the mechanical design aspects of a product, but can also evaluate the product's interaction with the human body to determine if a product is defective. Biomechanics is also utilized in determining the nature and cause of amusement ride, playground, swimming pool and fall injuries. In general, anytime there is an injury, a biomechanical engineer may be able to determine the nature and cause of the injury based upon environmental conditions, accident dynamics, and the medical diagnosis. Below are lists of areas in which a Biomechanical engineer may get involved.

### SPORTS AND RECREATION

- Amusement rides
- Athletic footwear
- Bicycle accidents
- Exercise equipment
- Gymnasium equipment
- Playground accidents
- Playground equipment
- Protective equipment
- Roller skating
- Scooters
- Sports fields & flooring surface
- Sports related injuries
- Swimming pools
- Trampolines

## FORENSIC BIOMECHANICS

### VEHICULAR

- ATV accidents
- Bicycle accidents
- Bus accidents
- Low speed MVA
- Motorcycles
- Occupant dynamics
- Off-road vehicles
- Paratransit vehicles
- Pedestrian accidents
- Protective helmets & equipment
- Railroad accidents
- Restraint systems
- Trucking equipment
- Vehicle access systems

### OCCUPATIONAL AND PREMISES

- Automatic doors
- Bath tub accidents
- Bus & train doors
- Construction accidents
- Elevator doors
- Ergonomics
- Fall protection
- Flexible doors
- Guardrails
- Hard hats
- Industrial accidents
- Industrial equipment
- Lifting injuries
- Machine guarding
- Protective equipment
- Railroad equipment accidents
- Retail displays
- Slip, trip & fall accidents
- Stair & handrail
- Walking surfaces
- Wood & metal working tools

### MEDICAL DEVICES

- Biomedical devices
- Cryotherapy devices
- Hospital gurneys
- Laparoscopic tools
- Orthopedic appliances (braces)
- Orthopedic prostheses
- Surgical tools

### CRIMINAL

- Biomechanical reconstruction
- Mechanism of injury
- Vehicle occupant position

### IMPORTANT DISCOVERY REQUESTS

In order to perform a good Biomechanical analysis certain information needs to be ascertained during discovery. Much of the information that is needed by the Biomechanical Engineer can be easily overlooked or not thought of during the discovery process. Below are lists of information that may help improve the ability of a Biomechanical expert in evaluating your case.

#### Slip, Trip and Fall Cases

- A detailed description of the fall mechanics.
  - At what point during the gait cycle did the fall occur? (toe off, swing phase, heel strike or support phase?)
  - Which foot initiated the fall?
  - What were the other limbs doing at the time the fall was initiated?
  - Which direction did the plaintiff fall?

### **FORENSIC BIOMECHANICS**

- A commitment to the mechanism of the fall. (slip, trip, stumble, collapse, misstep, etc.)
- A description of the hazard that caused the fall.
- Request that your expert examine the reported defect.
- An exact location of where the fall initiated and where the plaintiff came to rest.
- A detailed description of how the plaintiff hit the ground.
- A detailed description of the plaintiff's final rest position.
- A description of anything that was being carried by the plaintiff when they fell.
- A description of the flooring material.
- A description of any reported foreign substances that may have been on the floor.
- A description of the footwear.
- Obtain the footwear, if available.
- Plaintiff's age, weight and height at the time of the incident.
- A detailed description of the plaintiff's injuries and how they believe them to be related to the fall.
- Obtain medical records that described the plaintiff's injuries and pre-existing medical conditions.
- Obtain diagnostic images and reports.

### **Motor Vehicle Accidents**

- A detailed description of the vehicle's dynamics before, during and after the incident.
  - Vehicle speeds prior to impact.
  - Quantify the movement of the vehicles after the impact.
  - Directions of impacts.
  - A detailed description of any damage to the exterior and interior of the vehicles.
  - Etc.
- A detailed description of the occupant's dynamics before, during and after the incident.
  - Pre and post-accident positions of head, body, hands, and feet.
  - Description of the occupant's movements during the incident. (Consider the movement of all parts of the body.)
  - Descriptions of the occupant's impacts with the interior of the vehicle.
  - Were the occupants aware of the impending impact?
  - Etc.

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- A detailed description of the pre-impact vehicle setup.
  - Position of seat.
  - Position of seatback.
  - Position of headrest.
  - Use of available seatbelt.
  - Position of steering wheel.
  - Etc.
- A description of any pre-impact problems with the vehicles.
- A description of any pre-impact distractions.
- A description of the roadway conditions.
- A description of the traffic control devices at the intersection.
- A description of the environmental conditions present during the incident.
- Request that your expert examine the vehicles before they are repaired.
- Plaintiff's age, weight and height at the time of the incident.
- Obtain medical records that described the plaintiff's injuries and pre-existing medical conditions.
- Obtain diagnostic images and reports.

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*The information presented in this booklet is intended only to be used as a guide in assisting clients concerned with or involved in the legal process where litigation or potential litigation is an issue. The information is further intended to inform clients that Consulting Engineers & Scientists, Inc. has both the expertise and the capability to provide direction and guidance in the specific disciplines and areas presented in this booklet. It is important to note that the information also is general and is not intended to completely cover the specific nuances of a particular matter. If there are any questions concerning this information, please feel free to contact us.*