Introduction

One can define forensic biomechanics as the application of biomechanics in the court of law. Although the judicial systems of the United States and Canada very frequently utilize expert witnesses in engineering as well as most disciplines of science, only the last three decades biomechanists were recognized and admitted to the court as expert witnesses to provide opinions in the forensic biomechanics field. Thanks to the efforts of a few individuals, the science of biomechanics is now well accepted by the officers of the court systems of North America. Biomechanists possess a combined knowledge of engineering mechanics, biology, human anatomy, and physiology which makes it possible for them to reconstruct and analyze accidents of all kinds.

Biomechanics in the Court of Law

In the Spring Quarter of 1973, I introduced a new graduate level course, EM 794, Biomechanics at The Ohio State University. It was about that time I received a call from an attorney in Columbus, Ohio, regarding a Jeep rollover accident in which a man was injured. That was my first involvement to serve as a mechanics/biomechanics expert witness. Before we can talk about forensic biomechanics let us take a look at biomechanics. During my new course preparation I had to come up with a definition of biomechanics as well as classification of various research areas encompassed by this interdisciplinary field. I accepted the definition given by Professor Y. C. Fung, i.e., “biomechanics is mechanics applied to biology”. Considering both mechanics and biology are very broad fields, one immediately realizes the very large number of topics which can be studied and investigated.

Research areas and topics in biomechanics can be viewed in a wide spectrum ranging from microscopic scale dealing with individual cells to macroscopic scale dealing with large organisms, human body being the center of attention. Considering the human body is our main interest and concern within this wide spectrum, we can identify four divisions of research. The first division deals with the study and determination of the mechanical properties of biological materials starting with individual cells, going through various soft and hard tissues and ending up with organs and complex body systems. The second division is concerned with analyses of response of the human body to physiological forces. This division includes topics such as locomotion, respiration, circulation and microcirculation. Analyses of responses of the human body to replaced parts and assistive devices constitute the third division. Both internal and external prosthetic and orthotic devices and biomechanical compatibility of these devices make up the major research areas in the third division. In the fourth and the last division we consider analyses of responses of the human body to forces whose origins are external to the body. In this division, all kinds of steady-state, transient, and random types of force and pressure applications can be cited. The nature of forces can be further classified as impact and impulsive type. An impact type of force requires contact of a particular body segment with an external object or with another body segment, whereas impulsive force on a body segment is caused by purely inertial type of loading without a contact with an external object. Although this classification was made in early 70’s, I believe it is still valid as far as forensic biomechanics is concerned.
Returning to the field of forensic biomechanics, perhaps with the exception of aforementioned second division, we observe that all other divisions of biomechanics may be useful for an expert witness in a litigation case. It is also noteworthy to point out that most forensic biomechanics cases require extensive knowledge of the last division, i.e. analyses of responses of the human body to forces and accelerations which are external to the body.

Based on my personal experience, forensic biomechanics cases may be put into the following categories:

1. Motor vehicle accidents and related injury cases (single and multiple vehicles involving single and multiple vehicle occupants and/or pedestrians),
2. Occupation related accidents and injury cases,
3. Product failure and related injury cases,
4. Sports and recreation related accident and injury cases,
5. Slip and fall accidents and related cases.

Whether one serves as a forensic biomechanics expert witness on the plaintiff’s or defendant’s side, one must perform essentially three tasks. The first one is a thorough investigation of the case, which may involve an accident reconstruction, inspection of broken part or failed device or product, reading depositions and examining the medical records, site visits and gathering relevant data. The second task for a forensic biomechanist is the analysis phase which should include determination of the mechanism of injuries and factors responsible for the causation of the accident. Needless to say, analysis should be based on sound scientific principles accepted by the expert’s peers and should be void of any theories which include speculations and conjectures. The last task is a formal written expert report which, at a minimum, should include sections dealing with materials reviewed, description of the accident or event, summary of the expert’s opinions, and a brief resume of the author at the end of the report. Although in some jurisdictions a written report may not be required, the expert witness is still obligated to provide an oral report to the attorney so that he or she can submit a brief to the court as well as to the opposing counsel to disclose opinions of the expert. A good report written by a reputable expert witness coupled with a solid deposition testimony of the expert play a very significant role in the out-of-court settlement of a case.

In this Keynote Lecture, several actual litigation cases from different areas will be presented with some detail. The importance of forensic biomechanics in both plaintiff and defense points of view, as well as the role of the expert witness in each case will be delineated.