Injury Biomechanics in Litigation Consulting and in the Laboratory: How real impact can lead to high impact

Peter A. Cripton¹,², Darrin Richards²

¹Orthopaedic and Injury Biomechanics Group, Departments of Mechanical Engineering and Orthopaedics and ICORD, University of British Columbia, Vancouver, Canada, cripton@mech.ubc.ca
²Synaptic Analysis Consulting Group Inc., Vancouver, Canada

INTRODUCTION
The worlds of litigation-related biomechanical injury reconstruction is vastly different but undeniably and closely linked to the world of academic injury biomechanics research. We will document some of the ways that these two fields are linked and can inform each other through case studies and discussion.

BACKGROUND
In a typical litigation biomechanical engineering reconstruction the biomechanical engineer is retained by a lawyer to answer one or more questions related to the specific mechanism of a particular injury that occurred and led to a lawsuit. Questions such as “was the vehicle occupant seat belted”, “which of the two occupants was driving when the incident occurred”, “was the occupant injured before or after being ejected from the vehicle” or “could the bicycle helmet have prevented the cervical spine and spinal cord injury documented in Figure 1 are examples of this context.

To answer these questions the biomechanical engineer uses a variety of tools including, first, an in depth analysis of the evidence from the subject incident and then injury databases, computer models, and published academic injury biomechanics studies in which the injury mechanisms of the body part(s) that were injured in the subject incident are studied in detail.

This is different than laboratory injury biomechanics research because: 1. The biomechanical engineer has no choice in what type of injury they will be asked to analyze 2. The timeline and scope of the project is well defined and often short 3. The injury occurred in the “real world” in a living person. This is very different than academic research because in the laboratory : 1. The injury to be studied is selected by the researcher 2. The projects can sometimes involve long timelines and 3.Injuries are often studied using cadaver specimens, crash test dummies or computational models – all of these are models of the in vivo injury but none of them can replicate the real-world conditions that the injury biomechanics consultant is faced with.

Because of the relative youth of the biomechanical engineering field and complexity and heterogeneity of human injury it often happens that data necessary (i.e. cadaver, surrogate or computational models of the injury event) for the litigation-related biomechanical reconstruction is not available for the injury reconstruction. This can serve to indicate poorly understood injury mechanisms and this in turn can act as motivation to design a laboratory study around the mechanism of interest.

METHODS
We will use case studies to demonstrate how a litigation related analysis would proceed and to demonstrate some examples of data that is not available from previous laboratory studies.

There is an example in the figure 1 below. In this head first impact, the person was traveling with sufficient velocity and energy to fracture the cervical spine in the manner shown and this is associated with a bone fragment contacting the spinal cord and causing spinal cord injury. An example law suit would be for an injured individual to sue the football manufacture and claim that the helmet was defective because it did not protect the neck.

DISCUSSION & CONCLUSIONS
We will use the case studies and context described to demonstrate current gaps in the injury biomechanics data and discuss how these weaknesses in the available data can be exploited to make high impact contributions to the engineering and scientific knowledge on specific injuries and novel methods to prevent them.

Figure 1: Mechanism of cervical spine and spinal cord injury in head-first impact. When the head hits the ground or another object and stops the neck is asked to halt the momentum of the torso.