



D27 Engineering Investigations of Quadriplegic Diving Accidents

*Laura L. Liptai, PhD**, BioMedical Forensics HQ CA/FL, 1660 School Street, #103, Moraga, CA 94556; *Jamie O. Norman, JD**, Litchfield Cavo, LLP, 251 S Lake Avenue, Ste 750, Pasadena, CA 91101; and *William N. Rowley, PhD**, Rowley Forensic Engineering Inc, 2325 Palos Verdes Drive, W, #312, Palos Verdes Estates, CA 90274-2755

After attending this presentation, attendees will better understand how forensic engineering principles are applied to quadriplegic diving incidents to determine how the incidents occurred and how Newton's Second Law and the Equations of Motion are applied to a headfirst dive into water. Attendees will also better understand how forensic engineering investigations assist the pursuit of justice in litigation and will be aware of some measures that can help to reduce or prevent occurrences of quadriplegic diving injuries.

This presentation will impact the forensic science community by demonstrating the collaboration of forensic biomedical engineering analysis and forensic mechanical engineering analysis in quadriplegic diving accident litigation. In this presentation, legal perspectives will be presented by counsel and forensic engineering sciences will be presented by forensic engineering experts.

Spinal cord injuries from diving accidents in swimming pools and natural bodies of water are costly, debilitating, and life altering. Due to the extreme and permanent nature of the injuries suffered, protracted and expensive lawsuits frequently arise from these incidents. In the forensic analysis of a quadriplegic diving incident, the biomedical engineer and mechanical engineer are uniquely situated to offer insights with respect to the quantification of forces and accelerations. Because of the multidisciplinary aspects of diving incidents, the biomedical engineer is able to tie the engineering aspects together with the medical diagnoses by the health care providers and forensic pathologists. Various head impact scenarios are analyzed from an engineering perspective and supported with analysis of physical evidence and/or experimentally verified test data.

The forensic investigations into cervical spine trauma from diving injuries in this presentation required both a forensic biomedical engineering analysis and a forensic trajectory analysis through air and water to the moment of impact to determine the causes of injury and identify other contributing factors. Through these analyses, the forensic experts determined whether the physical evidence was consistent with the injured diver's narrative of the precipitating events or if there was evidence of other causal factors.

The first information that needs to be obtained in a quadriplegic diving accident case is the biomedical information of the cervical spine trauma. The forensic biomedical engineer must analyze the fractures to the head and cervical spine sustained from the incident to determine the physical characteristics at impact that caused the fractures (i.e., the mechanism of injury), including: (1) the minimum amount of force at impact necessary to cause the injuries; (2) the velocity of the diver at the moment of impact; (3) the angle of the diver's body at the moment of impact; and, (4) the angulation of the diver's head to the diver's body at the moment of impact.

In the descending portion of a headfirst dive into water, a diver's body is an object in a freefall trajectory. By applying the equations of motion pertaining to freefall to the characteristics of the impact in a parametric analysis, possible dive solutions can be calculated. A dive into shallow water can originate from a jump from a standing position or from a moving start. A jump does not normally occur in a slip-and-fall or in a push. A dive caused by a push into shallow water typically has an increased dive angle because the push causes the diver to over-rotate.



Engineering Sciences - 2017

Based on the above-listed evidence from the trauma, in conjunction with other forensic evidence, the biomedical engineer and mechanical engineer collectively assessed whether the divers' trajectories were consistent with: (1) a slip and fall into shallow water; (2) a push into shallow water; or, (3) a dive into shallow water.

These forensic investigations demonstrated how spinal cord injuries occurred from diving accidents. At the end of the presentation, measures will be identified that help to prevent occurrences of quadriplegic diving injuries and the consequential personal injury litigation.

Quadriplegic Diving Accident, Cervical Spine Injury/Trauma, Personal Injury Litigation