



Engineering Sciences Section - 2015

D46 A Multidisciplinary Analysis of a Complex Motorcycle Fatality

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The goal of this presentation is to demonstrate the value of a multidisciplinary approach to the reconstruction of a fatal motorcycle crash.

This presentation will impact the forensic science community by presenting a case study where accident reconstruction, vehicle inspection, biomechanics of injury, structural and helmet testing, scene investigation, and innovative detailed analysis of the surveillance video all played an important role in resolving the cause of the crash and the timing available to the motorcycle rider.

A motorcycle rider sustained a fatal head injury when he attempted to avoid striking a semi-truck and trailer that made a U-turn in front of him. He was pronounced dead at the scene after landing in a grassy area behind a 66-inch wrought iron fence. He was wearing a non-DOT-approved novelty helmet and sustained a massive and unusual skull fracture. The accident occurred in the dark, early morning hours. There was little traffic and there were no witnesses to the event. The following questions had to be answered: Could the motorcycle rider have avoided the collision? How fast was he going? Did he or his motorcycle actually strike the semi-truck? What did his head strike and at what speed? Could his brain injury have been prevented or lessened had he been wearing a DOT-certified helmet? How did he end up on the other side of the fence? This presentation describes how these questions were addressed scientifically.

Although no one saw the accident, surveillance video was obtained from the security system at a nearby business. Because the video taken from a distance was of low resolution and at night, it was difficult to extract meaningful data from the video. A high-resolution camera was mounted in the same location and at the same angle. The images from both cameras were correlated in a photogrammetric study to identify distant landmarks and lights which were not easily discernable in the original footage. Speeds of vehicles on the adjacent roadway were also calculated. Using this data, it was possible to better approximate the speed of the motorcycle seen in the surveillance video. An accident reconstruction was developed using marks in photographs and at the scene that had not been considered in an earlier analysis. Subtle damage to the motorcycle and markings on the rider and his clothing were identified and correlated with contact to the rear of the trailer.

The motorcycle rider's novelty helmet showed that it was split in half. It was originally hypothesized that the damage was caused by striking a wrought iron fence post or the edge of the curb; however, closer examination showed contact marks from a distributed contact with dull irregular scratches, not the sharp or deep scratches one would expect in such an impact scenario. Instrumented helmet drop tests using a Hybrid III dummy head were performed using helmets similar to the subject helmet and a DOT-certified helmet of the same overall style. Helmeted heads were dropped onto curb sections, asphalt, and fence pieces from varying heights at speeds up to 21.5mph. Head accelerations and speeds were recorded. Through testing, the subject contact marks were shown to be inconsistent with a curb, roadway surface, or a fence impact.

Since the extensive fracturing on the subject helmet could not be reproduced in the testing, the actual impact was at speeds greater than the tested 21.5mph and the helmet impacted an object other than those tested. Using the information from the surveillance video, injuries to his body, the marks identified in the photographs, and damage to the motorcycle's handlebars, a final crash reconstruction was performed. Finally, a kinematic analysis revealed how, after making contact with the trailer and his motorcycle striking the curb, he was launched headfirst and face up over the fence into the trunk of a palm tree.

In conclusion, this complex analysis was effective in answering the questions posed, by considering and analyzing all the evidence available in a cooperative manner. Confluence of results from these various studies reveal what actually occurred in this massive head injury event.

Motorcycle Reconstruction, Novelty Helmets, Surveillance Video Analysis