C35 Comparison of DOT Certified Motorcycle Helmets and Novelty Helmets in Head Drop Tests

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After attending this presentation, attendees will understand the differences in injury reduction performance of motorcycle helmets that are certified to meet Department of Transportation (DOT) requirements and novelty helmets that do not meet these requirements.

This presentation will impact the forensic science community by demonstrating the differences in the injury reducing performance of two types of similarly looking and similarly priced helmets that do not provide similar head impact protection.

Currently in the United States, laws requiring all motorcyclists to wear a helmet are in place in 20 states and the District of Columbia, while 27 states require only some motorcyclists to wear a helmet. Only three states have no motorcycle helmet use law. Most helmet laws require motorcycle riders to use a helmet that meets the DOT Federal Motor Vehicle Safety Standard (FMVSS) 218. FMVSS 218 requires that in a 138.4cm drop test (5.2m/s) onto a hemispherical anvil, and on a 182.9cm drop test (6.0 m/s impact speed) onto a flat anvil, the peak head acceleration shall not exceed 400g. If the peak head acceleration exceeds 200g, the duration at 200g's must be less than 2ms, and if the peak head acceleration exceeds 150g, the duration must be less than 4ms.

Helmets that are similar in form to a motorcycle helmet designed for on-road use, but that are not certified by their manufacturer to meet the requirements of FMVSS 218 are often referred to as "novelty" helmets. According to the National Highway Traffic Safety Administration (NHTSA), the 2006 NOPUS survey, a probability-based observational survey of motorcycle helmet use in the United States, found that 14 percent of motorcycle riders use helmets that do not comply with FMVSS 218. To combat this problem, NHTSA issued a final rule on May 13, 2011 that changes the labeling requirements on helmets, making it more difficult to sell helmets with markings that resemble current DOT labeling; however, novelty helmets remain a safety hazard.

In the current study, the performance of a DOT certified half helmet and a similar looking novelty helmet were evaluated using a drop tower system. Six drop tests were conducted using a novelty helmet and a DOT certified half helmet. The helmets were placed on a Hybrid III dummy head that was instrumented with a tri-axial accelerometer at its approximate static center of gravity. The head was suspended from a drop tower and dropped onto an asphalt test bed. It was suspended such that the head was free to rotate on impact. The drop height was 152.4 cm, to simulate the height of an average-sized rider on a cruiser-type motorcycle. All data was recorded at 10 kHz. Axis orientation and data filters were used in accordance with SAE J211 Recommended Practice. For the novelty drop tests, the peak resultant head accelerations were 451g, 358g, and 473g for the left, right, and top impacts, respectively. The corresponding HIC_{36} values for the novelty drop tests were 3677, 2260, and 4201. For the DOT drop tests, the peak resultant head accelerations were 143g, 142g, and 243g, for the left, right and top impacts, respectively. The corresponding HIC_{36} values for the DOT drop tests were 739, 595, and 1681.

For this test series, the DOT certified helmet met the DOT criteria described above in all three impacts; however, the novelty did not meet the criteria for any impact. The peak resultant g's from the novelty helmets were 1.9 to 3.2 times higher than those of the DOT certified helmets, depending on head impact orientation. The HIC_{36} for the novelty helmets ranged from 2.5 to five times that for the DOT certified tests, again depending on head impact orientation. These results show that the DOT helmet was at least twice as effective at reducing the potential for head injury when compared to the novelty helmet.

A study by Scher et al., (SAE#2009-01-0248) was similar to the present study with the exception that the head orientation was fixed during impact, so that all head motion was constrained to one direction, similar to FMVSS 218 testing. On average, for the Scher study, the peak resultant g's from novelty helmets were 2.6 times those of DOT certified half helmets, and on average the HIC_{15} for novelty helmets was 2.9 times those of DOT certified half helmets. Thus, based on the average data presented by Scher, both studies showed similar reductions in head accelerations and HICs when using a DOT certified helmet rather than a novelty helmet.

The present study appeared to have higher magnitudes for peak acceleration and HIC for all drop tests when compared to the Scher study. However, because only average data was presented in the Scher study, and because the present study was limited to six tests, direct correlation cannot be accomplished. Possible explanations for the discrepancy between the studies include a constrained head versus a freely rotating head and head impact orientation. Further testing and more information regarding the Scher testing are needed to determine the basis for this discrepancy.

DOT Certified Motorcycle Helmet, Novelty Helmet, Head Drop Test