D21 Differential Protective Effects of Motorcycle Helmets Against Head Injury

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After attending this presentation, attendees will understand that motorcycle helmets provide differing degrees of protection against various types of head injury.

This presentation will impact the forensic science community by providing evidence from real-world traffic crashes that motorcycle helmets manage rotational acceleration less effectively than linear acceleration.

Background: Previous observational studies have clearly demonstrated that motorcycle helmets protect riders against head injury; however, the extent to which helmet protection differs across head injury mechanisms remains unclear. Most previous studies of real-world motorcycle crashes considered aggregate protection against head injury. Biomechanical research in cadavers, animals, and computer models has established that head injuries differ in their etiologies. Skull fracture requires a direct impact with a high-amplitude linear component, whereas concussion results primarily from angular acceleration of the head.[1-5] Injuries to the head caused by motorcycle crashes are likely to involve both linear and rotational forces.[2,6,7] This study examined helmet protection versus skull fracture, cerebral contusion, intracranial hemorrhage, and cerebral concussion in a consecutive series of motorcycle operators involved in traffic crashes in Kentucky.

Methods: Anonymized police accident reports, hospital inpatient claims, and Emergency Department (ED) claims for the years 2008 to 2012 were matched by probabilistic record linkage. The study sample included motorcycle operators with known helmet use who were not killed at the crash scene. Police accident reports were used to ascertained operator helmet use. Skull fractures, cerebral contusions, intracranial hemorrhages, and cerebral concussions were identified from the *International Classification of Disease, 9th edition, Clinical Modification* (*ICD-9-CM*) codes on the claims records. Generalized estimating equations were used to estimate the relative risks of each type of head injury for helmeted versus unprotected operators.

Results: Helmet protection against skull fracture (*Risk Ratio* (*RR)*=0.31, 95% *Confidence Interval (CI)=(*0.23, 0.34)), cerebral contusion (*RR*=0.29, 95% *CI*=(0.16, 0.53)), and intracranial hemorrhage (*RR*=0.47, 95% *CI*=(0.35, 0.63)) was substantial. The RR estimates represent the risk of each injury type among operators who wore a helmet, compared to operators who did not. RR<1 indicates a protective effect. The results for uncomplicated concussion (*RR*=0.80, 95% *CI*=(0.64, 1.01)) were inconclusive. The RR estimate (20% risk reduction) suggested a modest protective effect, but the result was not statistically significant.[8]

Conclusions: Motorcycle helmets were associated with a 69% reduction in skull fractures, 71% reduction in cerebral contusion, and 53% reduction in intracranial hemorrhage. This study concludes that current motorcycle helmets do not protect equally against all types of head injury. Efforts to improve management of rotational acceleration in motorcycle helmets should be considered.

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