# Simulation of Motorcycle Crashes with W-beam Guardrail: Injury Patterns and Analysis

## Abstract

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This study uses computer simulations to study the impact of a motorcycle with the conventional w-beam guardrail. A three-dimensional computer simulation of a scaled hybrid III 50th-percentile male dummy mounted on a motorcycle and colliding with a w-beam guardrail is carried out. A multi-body model of the motorcycle and finite element model of the guardrail are developed using commercially available software.

The simulation model is validated with a physical crash test conducted with same initial impact configurations. Impacts at speeds of 32, 48, and 60 km/h at an impact angle at 45 degrees are considered. The predicted forces and accelerations are compared with the biomechanical limits for each body part and the risk of injury to the rider are evaluated.

Speed was found to have a significant influence on the level of injury to the head, neck, chest, and femur. A significant reduction of the severity of injuries was found when the impact speed was reduced from 60 to 32km/h. The accelerations experienced by the head and chest are found to be higher than safe levels for impact speeds of 48 and 60 km/h. The biomechanical limit for the right femur is exceeded at all three considered impact speeds. Neck injuries are also a concern, with the predicted tension values and neck bending extent being higher than the biomechanical limit for the 60 km/h impact speed.

In light of these results, it is suggested that the design of guardrails should be reviewed with a focus on the safety of motorcyclists.