

Mechanisms of injury among cyclists and the influence of body center of gravity, as indicated by fatal injuries to pedestrians

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KEY WORDS: Safety, Protection for vulnerable road users, Injury mechanism, Forensic reconstruction (C1)

In response to the urgent challenge of significantly reducing the number of traffic fatalities, as outlined in the 12th Basic Plan for Traffic Safety, this study elucidated the injury mechanisms specific to cyclists from a forensic science perspective, using the mechanisms underlying fatal injuries in pedestrians as a reference.

The decisive factor distinguishing the mechanisms of injury between cyclists and pedestrians was the vertical offset of the body's center of gravity relative to the front edge of the vehicle's hood.

Because cyclists sit astride the saddle, their center of gravity is higher, and they are less likely than pedestrians to be struck directly in the lumbar by the front edge of the hood in a collision. As a result, they are less likely to suffer multiple pelvic fractures, which would be fatal for a pedestrian. Furthermore, as their lumbar avoids the front edge of the hood, their upper body remains in a seated position and moves horizontally across the hood, causing them to strike the windshield with their shoulders.

In pedestrians, the initial impact of the head against the windshield, followed by inertial forces acting on the torso, induces hyperextension or hyperflexion of the neck with the head as the fulcrum, leading to cervical spine and spinal cord injuries that occur in conjunction with fatal head injuries. On the other hand, in the case of cyclists, it was inferred that because the shoulder absorbs the impact first, direct impact to the head and mechanical stress on the neck are relatively reduced.

The findings from this study are expected to provide new perspectives for the development of vehicle structures and protective gear aimed at reducing the number of cyclist fatalities.



Fig.1 Typical deformation caused the cyclist collides with the car.

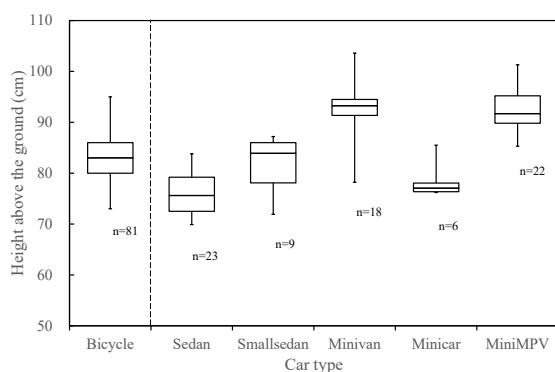


Fig.2 Boxplot of the bicycle saddle height and the engine hood leading edge height regarding the car types.

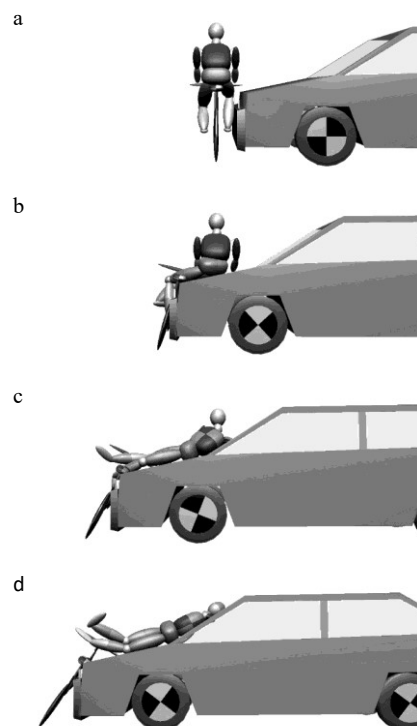


Fig.3 Kinematic behavior of the cyclist by the simulation program, "PC-Crash". a: Initial position. b: Their hip slides on the engine hood while the upper body keeps the sitting posture. c: Their shoulder collides against the windshield. d: Their head collides against the windshield rotating around their shoulder.