

Experimental Study on Car Collisions with Bicycles Equipped with Child Seats

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1. Introduction

In Japan, traffic accidents involving bicycles have become a serious problem with the increase in the use of bicycles. In recent years, bicycles equipped with child seats have become a popular means of transportation for preschool children in urban areas in Japan. Under such circumstances, it is necessary to conduct more studies and evaluations to prevent traffic accidents involving bicycles with children. For accident prevention and damage mitigation, this study mainly aims to clarify the situations of accidents involving bicycles equipped with child seats. Almost all child seats are equipped with seat belts, and some seats are equipped with headrest. Therefore, we evaluated the use of seat belts and headrests based on the behavior of child dummies in order to verify their protective abilities.

2. Method

We performed impact tests and crash tests.

The impact tests were performed using the equipment which have a child seat on a table. It is designed so that the seat rolls backwards and collides with the road surface. In the tests, a child dummy (Hybrid-III 3YO) was seated on a child seat, and the seat belt was fastened. The tests were conducted with and without the headrest of the child seat, and the effect of it was evaluated.

The crash tests that the front of a car hit the left side of a bicycle equipped with a child seat were conducted. An adult female dummy (Hybrid-III AF 05) rode on the bicycle and a child dummy (Hybrid-III 3 YO) sat on the child seat on the rear carrier. In the tests, the conditions of the seat belt and headrest of the child seat were changed, and the effects of each of them were evaluated. The test cars were sedan type, and the target collision speed of the car was 8.3 m/s (30 km/h), and braking was immediately performed after the collisions. The target collision speeds of the bicycle were 4.2 m/s (15 km/h) and 0 m/s.

3. Results

In the impact tests, the maximum value of the resultant acceleration of child dummy's head and the HIC were very high in the condition without the headrest. The headrest reduced the acceleration (reduction of about 72%), and the HIC to 346 (reduction of about 81%).

In the crash tests, the adult and child dummies rotated toward the hood and hit it, while the bicycle and the lower half of the adult dummy were pushed in the car's direction of travel after contact with the front of the car. After that, as the car braked, the dummies fell to the front of the car and collided with the road surface. The behavior of the child dummy changed significantly based on whether the seat belt was fastened around the dummy or not. In the condition that the seat belt was not fastened, after contact with the front of the car, the child dummy slipped out of the child seat while rotating toward the hood. However, in the condition that the seat belt was fastened, the child dummy moved together with the bicycle while sitting on the child seat from the start of the collision until the complete stop. In the condition of using the seat belt and headrest, the headrest prevented the child dummy's head from directly colliding with the road surface, whereas the head directly collided with the road surface in the other test conditions.

4. Conclusions

In this study, impact tests were conducted to evaluate the effect of the presence or absence of headrests with child seats, and it was confirmed that headrests reduce the impact on the head in the collision with the road surface.

Crossing collision tests between a car and a bicycle equipped with a child seat were conducted, and the effects of the seat belt and the headrest of the child seat were investigated. It was found that the use of headrests and seat belts can reduce the risks of injury to children in the case of a collision with the road surface.

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