COMPUTER SIMULATION OF MOTORCYCLE-CAR ACCIDENT

Cheng-Yu Wu, Saiwei Yang,
Institute of Biomedical Engineering, National Yang Ming University, Taiwan
email: swyang@ym.edu.tw, web: http://rehab.ym.edu.tw

INTRODUCTION

Motorcycle is a highly mobile transportation vehicle, due to least or no add-on protective device for the motorcyclist the accidence is to result in severe spinal injury or fetal death. Head, knee and leg are reported over 45% of injury rate [1]. The accident reconstruction presentation is necessary to inspect the rationale and mechanism of accident occurring and responsibility due, For the purpose of injury mechanism and protection devices development computer simulation has been used extensively [2, 3, 4, 5].

The purpose of this study was to construct a light weight motorcycle-automobile accident computer simulation to understand the impact locations and forces on the body segments for the accident presentation and protective device development.

METHODS

A motorcycle weighted 100Kgs and a car weighted 1200Kgs were modeled using ADAMS 11.0 (MSC software Co., USA). The motorcyclist was simulated as Hybrid III50% and constructed using LifeMod (Biomechanics Research Inc, USA). In addition, **Standard Pendulum-Hybrid III** impact experiment was used to validate computer construction of the dummy. Four common collision types were studied namely head-on, 90 degrees lateral impact, 45 degrees side-swipe, and bumper-rear-end collision.

.

RESULTS AND DISCUSSION

The pendulum-dummy simulation showed well correspondence in acceleration-time slope. In the head-on collision simulation the motorcycle had speed of 35 Km/hr and car was 55 Km/hr at the time of collision. The head was hit on the windshield first with impact force of 7586N and then the head hit the ground first in prone position with force of 15,874 N (at time of 0.85 second)(Fig. 1). For the 90 degree side collision, the motorcycle speed was 34 Km/hr and car was35 Km/hr, the motorcyclist had the arm and head hit on the front hood with impact force of 6976N and then had the shoulder hit on the ground in supine position first then turned to site wall(Fig. 2). The impact on the scapular was 10,033N (at 0.75 second). For the 45 degree-side collision, the speed of motorcycle and car was 35 and 55 Km/hr, respectively. The head hit on the engine hood first (at 0.93 second) and then fell across the hood with head on the ground (650N, 1.19 second) in prone position. For the bumper to rear collision, the speed of motorcycle and car was 22 and 62 Km/hr, respectively. The buttocks were hit on the hood first with impact force of 9507N, then thrust anteriorly to the ground with butt hit first (Fig. 3). The force on the butt was 11320N and 9391N on the head at the time of impact to the ground.

Fig. 1 : Head-on collision

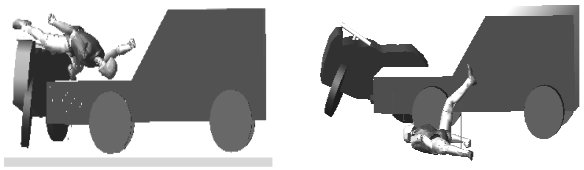

Fig. 2 : 90 degrees side impact

Fig. 3: Bumper to rear end collision

CONCLUSIONS

The simulations showed the head was the most injured part, especial impacted to the ground after crashed by a car in any direction. 90 degree side collision resulted in shoulder severe injury when impacted to the ground. The bumper to rear end collision created a large momentum and resulted in sacrum-back trunk severe injury.

This simulation demonstrates a useful means for the motorcyclist garment development.

REFERENCES

1. Bradbury A, et al. *Scotland. Health Bulletin*. 51(2):86-91, 1993 Mar.
2. Nieboer JJ, et al.*TNO Crash-Safety Research Centre Delft*,Nov. 4-7,1991
3. McGuan S. *SAE 930226*,1993.
4. Wang YO, et al. *SAE* , 1999-01-0719.
5. Giavotto V, et al. *International Journal of Crashworthness,* Vol. 3, No. 5, pp. 328-336.,1998.

ACKNOWLEDGEMENTS

This study was supported by National science Council of R.O.C. (NSC91-2622-E010-006, 93-2213-E010-008).