Traffic Injury Prevention, vol.23, no.4, pp.181-186, March, 2022.

Assessment of in situ chest deflection of post mortem human subjects (PMHS) and personalized human body models (HBM) in nearside oblique impacts

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Abstract-

Objective

The present study has three objectives: First, to analyze the chest deflection measured in nearside oblique tests performed with three post mortem human subjects (PMHS). Second, to assess the capability of a HBM to predict the chest deflection sustained by the PMHS. Third to evaluate the influence on chest deflection prediction of subject-specific HBM.

Methods

Three dimensional chest deformation of five anterior chest landmarks was extracted from three PMHS (A-C) in three sled tests. The sled test configurations corresponded to a 30 degree nearside oblique impact at 35 km/h. Two different restraint system versions (RSv) were used. RSv1 was used for PMHS A and B while RSv2 was used for PMHS C. The capability of the SAFER HBM (called baseline model) to predict PMHS chest deflection was benchmarked by means of the PMHS test results. In a second step, the anthropometry, mass and pre-impact posture of the baseline HBM were modified to the PMHS-specific characteristics to develop a model to assess the influence of personalization techniques in the capability of the human body model to predict PMHS chest deflection.

Results

In the sled tests, the measured sternum compression relative to the eighth thoracic vertebra in the PMHS tests was 49, 54 and 55 millimeters respectively. The HBM baseline model predicted 48%, 43% and 34% of the deflections measured in the PMHS tests, while the personalized version predicted 38%, 34% and 28%. When chest deflection was analyzed in x-, y- and z-direction for the five chest landmarks it was found that neither the baseline HBM nor the personalized model predicted x, y and z axis deflections.

Conclusions

The PMHS in situ chest deflection was found to be sensitive to the variation in restraint system and the three PMHS exhibited greater values of lower right chest deflection compared to what was found in available literature. The baseline HBM underpredicted peak chest deflection obtained in the PMHS test. The personalized model was not capable of predicting the chest deflection sustained by the PMHS. Hence, further biofidelity investigations have to be carried out on the human body thorax model for oblique loading.

Index Terms- Chest deflection; human body model (HBM); nearsideoblique impact; post mortem human subjects (PMHS)

Citation:
Piqueras, A.; Pipkorn, B.; Iraeus, J.; Maza, M.; López-Valdés, F.J. "Assessment of in situ chest deflection of post mortem human subjects (PMHS) and personalized human body models (HBM) in nearside oblique impacts", Traffic Injury Prevention, vol.23, no.4, pp.181-186, March, 2022.