Validation of a human head FE model subjected to the impact by falling objects such as ceilings

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Abstract

Falling objects cause accidents somewhere in the world in everyday life regardless of whether earthquakes occur or not, e.g. interior and exterior finishes such as ceilings, equipments, sign boards, and so on(Fig.1). The falling objects often hurt people, and head injuries that easily occur are especially likely to be severe damage. The reseaches on the human safety have been mainly developing in the field of the trafic trauma biomechanics. They are mostly aimed at the occupant protection in the case of the frontal, rear-end and side impact on vehicle. Therefore, there is no way to evaluate the damage to vertices(human heads) caused by the impact from just above. To evaluate the quantitative risk and elucidate the head injury mechanism are quite important for giving the first priority to the human safety also in the field of architecture. In this study, for the purpose of validating the three-dimensional digital human head finite elelment(FE) model (Watanabe et al., 2009)[1)] subjected to the impact from just above, the results of an impact test to vertex of a human cadaver conducted by Yoganandan et al.[2)] and the dynamic analysis simulating Yoganandan's experiment using the head FE model were compared. As shown in Fig.2, this model was built up by the VOXEL method using 216 CT images and composed of more than one hundred hexahedral solid elements representing ten anatomical properties such as brain and bones. The obtained force-displacement curve on the analysis showed the hardening characteristic as seen in the Yoganandan's experiment. The authors anticipate our simulation to be a starting point for the new damage evaluation method focused on not only the maximum force but also the stress and its duration.

Fig.1 Ceiling collapse occurred in a school gymnasium

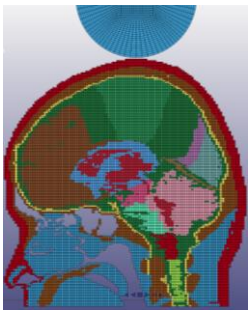

Fig.2 Human head FE model

References

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