- **TITLE: Preriminal Study of Cerebrospinal Fluid Modeling Using Smooth Particle Hydrodynamics in Simplified Human Head Model**

- **ABSTRACT**

Various human head FE models have been developed to clarify the mechanism of Traumatic Brain Injuries (TBIs) and to investigate injury criteria. In most of these models, solid elements are used to model the Cerebrospinal Fluid (CSF). In the solid modeling, the boundary conditions between the CSF and the skull that transfer the pressure are limited. In addition, the movement of the brain relative to the skull depends on the deformation of the solid CSF when such boudary conditions are applied. Thus, although these models have shown that the intracranial pressure is in good agreement with experimental data, the cerebral displacement has been underestimated. One of the reasons is the low acceptance of a large deformation of the CSF modeled with solid elements that is likely to produce a negative volume of the elements.

In order to improve the underestimation of the cerebral displacement, this study investigated the modeling of the CSF by applying the Smooth Particle Hydrodynamics (SPH) method to a simplified cylindrical head-brain model to allow a large deformation of the CSF.

The modeling method of the CSF using SPH that best describes the intracranal pressure was identified by comparing the pressure between SPH and solid modeling. A computational stability of the models was also compared when the CSF was largely deformed.

As a result, the modeling method of the CSF using SPH which satisfies the following was identified: 1)The intracranial pressure in the simplified model was equivalent to the solid model; and 2) A larger deformation of the CSF is reproducible with the computational stability than the solid model. Thereby, it was suggested that the CSF modeling by SPH potentially clear up the issue of the underestimation of the cerebral displacement when solid modeling is used, while maintaining the accuracy of the intracranial pressure.

(297 words)