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Impact Simulation related to the Mechanism of Diffuse Brain Injury using the Voxel Head Model

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ABSTRACT

The simulation of the head subjected to a non-impact rotational acceleration was conducted to understand the mechanism of the diffuse brain injury including the diffuse axonal injury (DAI). It is known that the diffuse brain injury frequently occurs in motor vehicle accidents. Gennarelli et al. [1] proposed that DAI occurs while a head is subjected to rather a rotational impact than a translational impact. The obtained result shows that the higher stress occurred in deep area of brain near the leading edge of a falx cerebri and tentorium cerebelli. (Fig. 1, 2) It was confirmed that the greater stress areas of the brain matched the fact that DAI often involve the injury in a corpus callosum and a brain stem. Moreover, the localization of brain function in the higher stress areas corresponds to the residual disability in DAI. We expect that the injury in a brain stem and cerebral limbic system is the essential of DAI.

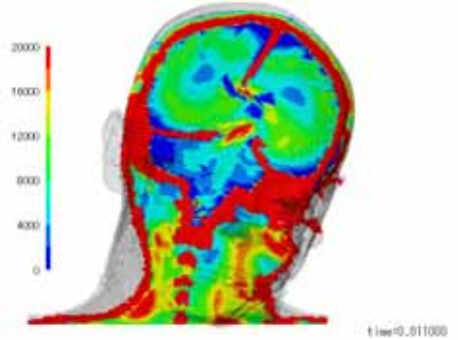

Fig. 1 Mises stress distribution in a coronal plane at 11ms [Pa]

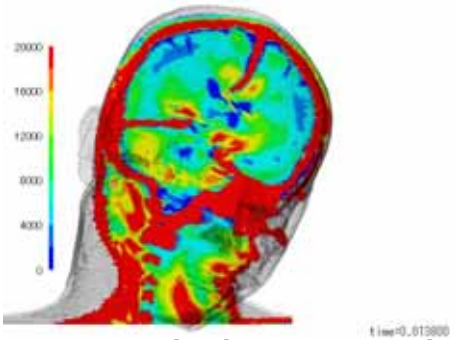

Fig. 2 Mises stress distribution in a coronal plane at 13.8ms [Pa]

Next, we conducted the similar simulation, in same boundary condition, using the model without a falx cerebri and a tentorium cerebelli to discuss the cause of the injury in a brain stem and a limbic system. The obtained result (Fig. 3, Fig. 4) showed that greater stress areas didn't occur in a brain stem and a limbic system. So membrane tissues, a falx cerebri and a tentorium cerebelli, could involve the diffuse brain injury.

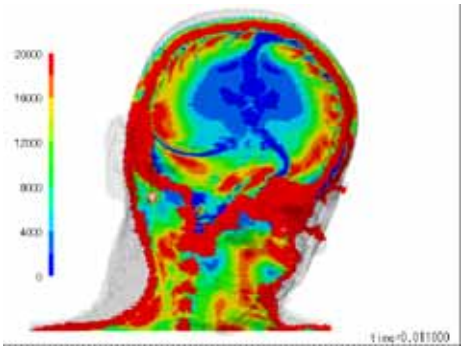

Fig. 3 Mises stress distribution in a coronal plane at 11ms [Pa]

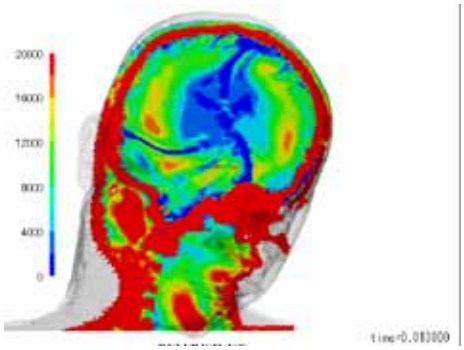

Fig. 4 Mises stress distribution in a coronal plane at 13.8ms [Pa]

REFERENCES

[1] Gennarelli, T. A. et al., "Diffuse Axonal Injury and Traumatic Coma in the Primate", *Annals of Neurology*, Vol. 12, No.6, pp. 564-574, (1982)