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Title: **Analysis of biomechanical parameter changes in brain tissues due to dynamic loads**

Traumatic brain injury (TBI) is one of the most severe illness in the contemporary world. The main causes of brain tissue damage are mechanical overloads which act on the brain during traffic accidents, sports injuries, falls and also in the acts of violence. Detection of brain structure damage is of crucial importance in the aspect of prevention and treatment of TBI, and consequently, in the enhancement of security of modern communities by reducing the duration and costs of treatment. **The main objective of the PhD thesis was to analyze the effort of brain tissue structures under conditions of rapid overloads. The significant element of the research was the development of a numerical model, with the use of imaging methods, that made it possible to assess changes in the mechanical properties of brain tissue structures caused by rapid overloads.** The model referred to the results of experimental studies made on human corpses. A proper modeling of individual tissues was the key issue in achieving good compatibility with experimental studies – and thus in a reliable reflection of brain biomechanics in the numerical model. On the basis of the research work performed it was found among others that the inclusion of the falx celrebri and the tentorium cerebelli in the numerical model is a crucial element of the correct assessment of brain damage biomechanics. Moreover, it was proved that the hyperelastic Mooney–Rivlin material was the best model for brain tissues in the head geometry that was developed. Relative displacements of the brain are now considered to be – and most frequently described in the literature – the main factors of brain tissue damage. **Thus, the PhD thesis addresses also the effect of mechanical properties of brain tissue and bridging veins on brain displacement relative to the skull due to mechanical loading**. It was proved that bridging veins have a significant influence on brain displacement relative to the skull. This fact is of particular significance especially when contre coup injuries are analyzed. A thorough analysis of the literature showed that bridging veins belong to structures most susceptible to damage caused by mechanical overload. However, the descriptions of mechanical properties and geometric parameters of these structures differ to a great extent. Having regard to the significant divergence of bridging veins biomechanical parameters – and also to a vague manner of modeling these elements in numerical models – in this thesis, deformations of bridging veins were analyzed based on their biomechanical parameters. The assessment of the deformation ability of bridging veins in elderly patients was an important element of the research. **The analyses showed a relation between physical parameters of bridging veins and the brain and the deformation ability of these veins.**

The numerical model of the human head validated on the basis of experimental results may in future improve the design of head protection systems and the assessment of biomechanical criteria of head injuries. It may also facilitate the reconstruction of accidents (traffic and sports injuries) as well as detection and prediction of brain tissue injuries. The research carried out is a significant contribution to the development of biomechanical analysis of traumatic brain injuries and human head modeling.