

The aim of the project is to conduct a comprehensive analysis of the behavior of the walls of the orbital bone and adjacent craniofacial bones in humans as a result of the injury. The analysis will include both strength laboratory tests completed by the identification of physical parameters of the bone building orbital wall, as well as a computer-assisted injuries analysis (nonlinear dynamic analysis). Additional objectives will also: determination of the mechanical constitutive model of the orbital area, numerical determination of most dangerous patterns of bone injuries and to determine the placement of the potential damage zones depending on the direction and size of the force.

The project will proceed in five stages. In the first mechanical orbital bone research laboratory will be made from human corpses. As the result will be the next step, which is to carry out the identification of physical parameters of the bone building orbital wall. On this basis, in the third stage, will be built computer models (using the finite element method-shell and solid finite elements) of the skull. Then, in the context of the fourth phase will be carried out non-linear dynamic analysis with different types of impulse loads (large, short-term growth and a fall in the value of the force as a function of time). As a result of this stage, in the final stage, will be selected the most dangerous schemes of forces in and around the eye socket, depending on their characteristics (size, direction, distance between individual impacts) and the resulting potential areas of Craniofacial bone damage.

Another advantage of the project is its interdisciplinary nature, because the implementation of tasks will be possible thanks to the creation of a combined both with specialist doctors, and specialists involved in testing and identification of mechanical properties of materials and computer modeling by the finite elements method. The study will be to complement and extend the existing preliminary tests carried out by our team of researchers. With the planned research is expected to clarify the many hypotheses about the orbital injuries, among other things: the location, the size of the forces needed for causing damages of the orbital walls, the answer to the question: why most fractures of the lower walls has the shape of an ellipse, or specifying the reasons for the air presence in the Interior of the eye socket after some injuries. Such studies have not been conducted, what makes that they have an innovative and interdisciplinary character. The results obtained can in the future to expand the state of the art in the field of basic science, concerning discipline of medicine and mechanics. In addition, they can also be used for the construction of protective security devices, and to the creation of individual "patterns" of damage within the orbital cavity, on the basis of which it will be possible to determine the direction and magnitude of force based on the images of the clinical and radiological patients after such trauma, what is of great importance in the case-law of the Court. Within the framework of the grant completion two dissertations and the publication of results in journals from the list of Web of Science is planned as well as presentation of the results during scientific conferences, both medical, engineering, and interdisciplinary (biomechanics).