Abstract of the dissertation

Title: The use of biomechanics as a supporting argumentation for the conclusions of expert opinions

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The aim of this dissertation is to map the mechanical properties of the bones of the face and skull from the available literature and to describe the mechanisms of brain and cervical spine injuries. The description of these mechanisms contributes to the elucidation of the origin of injuries from a purely mechanical/biomechanical perspective, and in forensic practice contributes to the understanding of the situation by other engineering professions not involved in forensic medicine. The strength and stiffness parameters of the bones of the face and skull are used to determine the magnitude, direction and location of possible forces for fracture formation, etc. Another objective is to propose and describe a simple analytical approach for determining the velocity of the head when striking the windshield of an automobile. To address the dependence of head impact velocity and car speed, and the effect of windscreen tilt. Using experimental testing, to describe the defects produced on the windscreen of a car after a crash of an impactor (simulation of a head impact against the windscreen) at different impact velocities.

Determination of the velocity of head impact on the windscreen of the car during the pedestrian-car collision was solved in two variants. The first variant, where the deformation effect of the body on the front of the car was neglected, it was assumed that the centre of gravity of the figure after the impact moves at the same speed as the vehicle that hits it, and it was assumed that all the impact energy is converted into kinetic energy of rotational motion. The impact velocity of the pedestrian's head into the windscreen of the car is then approximately twice the velocity of the car at the moment of impact with the figure. This fact changes the idea of uninitiated persons that the speed that causes injury in a traffic accident is equal to the speed of the vehicle. In the case of a crash, the body's center of gravity does not move forward as fast as the vehicle, but moves slower, which is also a realistic situation. Due to this fact, the angular velocity is also lower, and the resulting impact velocity of the head on the windshield is about one and a half times the speed of the vehicle, in absolute value. The direction of velocity is of course against the windscreen, but not perpendicular. The direction of velocity is determined by the angle which is lower to the X-axis than if it were perpendicular to the windscreen.

It has been determined by calculation that the velocity of the head impact to the windscreen decreases with decreasing windscreen inclination at the same vehicle velocity.In testing the vehicle windshield with an adult head impactor, impact velocity, acceleration, contact time, puncture diameter on the vehicle glass, and puncture depth on the vehicle glass were monitored. All measured data approximately matched the published results. At the edge, the deformation is smaller, the fit is stiffer and the acceleration is greater, hence the risk of injury near the windscreen fit is higher.

In forensic investigations, all the results of this work have their application, whether newly measured or calculated parameters, as well as an overview of strength and stiffness characteristics, since simulations cannot cover everything, and at least to get an idea of reality, it is advisable to accept the data from experiments. In the application of the knowledge to the example of solving an expert opinion of a car crash with injuries, the knowledge of the dimensions of the windshield defect in relation to the speed at their occurrence would be applied, and the expert opinion would not need to be revised by a revision expert opinion.