DESCRIPTION FOR THE GENERAL PUBLIC

The cornea is a transparent, convex, outer membrane of the anterior segment of the eyeball. Together with the tear film it is the first optical element of the eye with the highest optical power. Therefore, it has a substantial impact on the quality of the image formed on the retina. One of the most interesting biomechanical properties of the cornea is viscoelasticity, manifested by stiffness of the cornea under fast load application, deformation under constant stress and a presence of hysteresis, which is the difference in corneal behavior during loading and unloading.

Many diseases leading to visual impairment are associated with the biomechanical properties of the eye. For instance, keratoconus is due to thinning of the cornea, which leads to excessive bulging and results in the distortion of observed images. On the other hand, too high intraocular pressure (IOP) may be the main cause of glaucoma, a disease which can lead to irreversible blindness. It has been observed that the eye affected by glaucoma has different biomechanical properties than the healthy eye. Biomechanical properties of the cornea are also important in predicting the final effect of surgical vision correction.

According to the Laplace's law, the value of IOP can be calculated knowing the corneal tension distribution and the radius of corneal curvature. This law, however, does not take into account the mechanical properties of examined structures. For this reason, the measurements of IOP applying it are burdened with the error resulting from the impact of biomechanical parameters of the cornea. There are several methods for measuring IOP, but each of them has limitations and shows a dispersion of the obtained values. Moreover, the phenomenon of IOP pulsation, which is associated with the blood pulsation in the structures of the eye, may also have an effect of increasing this dispersion.

The aim of this project is to deepen understanding and attempt to parametric description of the dynamic corneal deformation, which occurs during non-contact measurement of IOP using air-puff. Obtained results will help in better understanding of the relationship between biomechanical properties of the cornea, intraocular pressure and condition of the eye.

Under the project, a group of patients will be examined in a series of synchronous measurements: blood pulse using an oximeter and intraocular pressure using air-puff tonometers. One of them is the modern tonometer Corvis ST, equipped with ultra-high speed camera (4375 frames per second), which allows to register a sequence of 140 images of the dynamic changes in shape of the corneal profile caused by an air blast. On this basis, the instrument software determines a number of parameters describing these changes and the value of intraocular pressure.

Based on the obtained sequences of images, new parameters describing the behavior of the cornea will be sought. Furthermore, correlation relationships between the obtained values and the exact times of measurements in the pulsing blood cycle will be analyzed. The proposed new parameters can potentially be used in description or diagnostics of biomechanical properties of the anterior segment of the eye (especially the cornea) and their dynamics related to the heart activity.