

ACMIT

Austrian Center for Medical Innovation and Technology

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Simulator for intraocular lens implants contributes to optimized vision quality based on individual parameters

Within the framework of ACMIT a simulator was developed for artificial intraocular lenses (IOLs), which are commonly implanted for treatment of cataract. This simulator device enables the evaluation of optical lens characteristics of the implants while considering the human visual apparatus even without implantation. Hence, in the development of innovative IOL concepts and designs the gap between a merely technical evaluation and cumbersome implantation studies can be closed. Furthermore, future works could allow for consideration of individual patient needs at an even better level than it is possible today.

Cataract

A cataract - also known as grey star - is a clouding of the natural human lens which often occurs with increasing age. During treatment of cataracts this natural lens is usually removed and replaced by an artificial lens implant. This procedure is one of the most frequently performed surgical interventions worldwide. In the Western civilization the number of cataract operations is increasing, particularly because of the progressively aging population. While in 2010 approximately 18.9 million interventions have been performed worldwide, in Germany this number reached approximately 650 thousand.

Intraocular lenses

Intraocular lenses (IOLs) as artificial implants for cataract surgery are getting refined and improved continuously since their introduction through Sir Harold Ridley in 1949. These developments range from foldable lenses for minimal invasive surgery (micro-incision sur-

gery), the application of blue light filters for protecting the retina, haptics with increased position stability to pseudo-adaptive optics, which at least partly counteracts the loss of accommodating ability which goes along with cataract treatment described above.

Development

Within the framework of its research and development activities in the COMET program, ACMIT not only deals with the design of innovative optical elements like the above mentioned pseudo-adaptive optics. The K1 center also goes for an innovative approach in testing novel concepts and designs for their subjective acceptance already during the development process and without implantation.

It is known by now that besides the physical differences which are already considered in the routine operation like the eye length or the refraction power of the cornea, also a multiplicity of other individual parameters like the activity profile of the patients, personal visual preferences or neuronal image processing play a

leading role in choosing the right lens design. Therefore, the same lens design is usually not the most appropriate for everyone. Nevertheless, those factors are hardly considered when choosing a suitable lens design. This is certainly due to non-existing standards in quantizing and comparing personal preferences on the one hand. But on the other hand, the ophthalmologic community also lacks an adequate awareness of this important parameters yet.

First steps in this direction could be achieved with an IOL simulator setup – developed by ACMIT in cooperation with its scientific and industrial partners. This device provides the possibility to optimize vision quality in terms of individual preferences.



Fig. 1: IOL Simulator Setup (ACMIT Copyright)

Figure 1 shows a version of this IOL simulator, which can already be employed during the development process of lens implants for subjectively evaluating new concepts by test persons. The simulator is equipped with artificial model eyes where commercially available IOLs can be placed in. Test pictures can then be

projected directly onto the retina via a relay-optics system whereby the test person is given the impression of already implanted IOLs. So far a couple of first questions has already been addressed in a series of clinical investigations with this IOL simulator setup.



Impact and effects

Besides performing standardized test procedures like the determination of the visual acuity via ETDRS charts or identification of the contrast sensitivity by application of FACT tests, the setup, for example, also facilitates to present 3D scenarios from everyday life and let them be individually assessed by test persons. This in turn enables an evaluation of the optical characteristics of the implant considering the human visual apparatus even without implantation of the particular lens. The IOL simulator therefore closes the gap between a merely technical evaluation on the optical bench and cumbersome implantation studies with their interrelated ethical issues. Furthermore, this device allows a direct comparison of different optics in a pseudo-postoperative state for the first time. In addition, it can be also used to visualize the patients' postoperative sight for ophthalmologists and sensitize them for existing differences in the optical designs of commonly used implants.

In the future, the IOL simulator could be further developed for clinical use in directed and purposeful patient information by demonstrating patients the differences provided by several optic designs. Thus, patients could choose their favored optics according to their individual needs which then can be considered in an optimum way.

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