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Innovation in retinal diseases – ultra-widefield imaging

Abstract

The understanding of retinal disease has evolved rapidly with a growing number of clinical evidence supplied by ultra-widefield retinal imaging.

Optos 200Tx ultra-widefield retinal imaging system uses a scanning laser ophthalmoscope, as well as an ellipsoid mirror. This creates a possibility of making a virtual focal point inside the eye and, in turn, enables the system to simultaneously make a single capture of the central retina and periphery. This system offers multimodal ultra-widefield imaging, including color photographs, fundus autofluorescence images, red-free images and fluorescein angiography (FA), allowing visualization of the retinal circulation. For color photographs, green and red lasers are used simultaneously to allow visualization of retinal substructures from the sensory retina and retinal pigment epithelium to the choroid.

In our clinic ultra-widefield fluorescein angiography has became an elegant diagnostic imaging modality that has improved our ability to diagnose and plan treatment strategies.

In the future widefield imaging will probably be coupled with OCT (optical coherence tomography) option to better evaluate retinal pathologies in the periphery.

Keywords: ultra-widefield imaging, fluorescein angiography, fundus autofluorescence, red-free image, optical coherence tomography.

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INTRODUCTION

Throughout recent years, diagnostic imaging has been playing an increasingly important role in ophthalmology. Huge improvements in the areas of diagnostics and treatment decision making are possible due to the presence of modern diagnostic medical devices whose work is even further improved by imaging technologies. This article will analyze the use of new technologies that retinal specialists might find useful for exploring new fields of research. Until recently, the retinal periphery was hard to capture, particularly if one used the "one-shot" method.

By default, fundus cameras provide a 30-50° field of view. In order to capture a somewhat larger picture (e.g. the peripheries of the picture,) one could change the camera's angle. Imaging angles larger than 50 degrees have been described as "wide-field". With seven standard fields photographs, a 75° view of the eye fundus can be obtained. The term "ultra-widefield" has yet to be accurately defined, but it gained popularity after introducing images with more than 150 degrees field of view.

During the last few years, a new system – OPTOS 200Tx system (by Optos PLC, Dunfermline, United Kingdom) – has been introduced. The system operates on the basis of a scanning laser opthalmoscope equipped with a modern mirror system. At the moment, OPTOS is one of the most widely used ultra-widefield noncontact cameras available on the market. This system utilizes an ellipsoid mirror to create images with approximately 200° field of view. This means, more than 80% of the fundus is captured in one shot. Using this instrument, it is possible to obtain simultaneous evaluation of the peripheral, as well as the central, retina with very good resolution. Optos offers multimodal imaging, including color photographs (Figure 1), fundus autofluorescence (Figure 2), fluorescein angiography (FA) (Figure 3) and red-free images. Improved exploration of retinal substructures is possible due to green and red lasers applied from the sensory retinal layers and retinal pigment epithelium to the choroidal layer.

Ultra-widefield systems have proven very helpful in diagnosing many retinal pathologies, particularly those of ascular nature, including the most popular ones, like diabetic retinopathy [1,2], retinal vein occlusions [3,4], choroidal masses [5], uveitis, retinal vasculities [6,7] and retinopathy of prematurity [8].

Our clinical experience

Optos 200Tx system was introduced in Department of Retinal and Vitreous Surgery, Medical University of Lublin in 2012. Taking numerous fluorescein angiographies, color photographs and autofluorescence images is part of the

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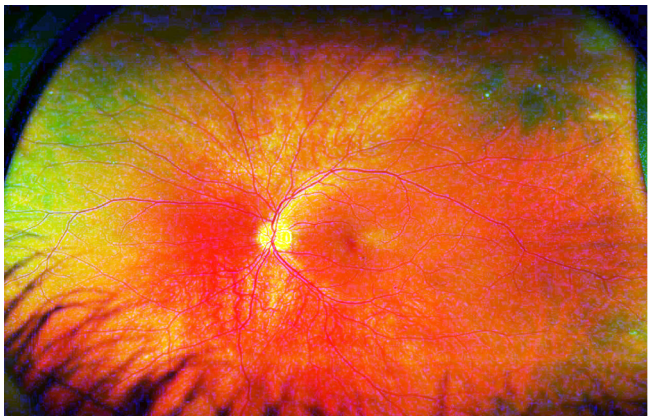

FIGURE 1. Widefield color fundus photograph of normal eye.

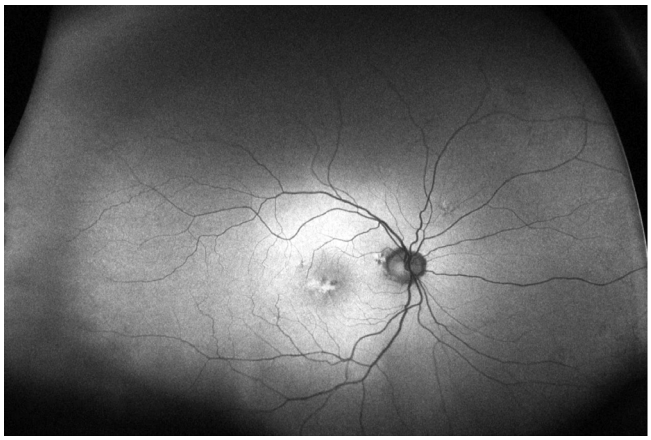

FIGURE 2. Ultra-widefield fundus autofluorescence image of the patient with macular degeneration.

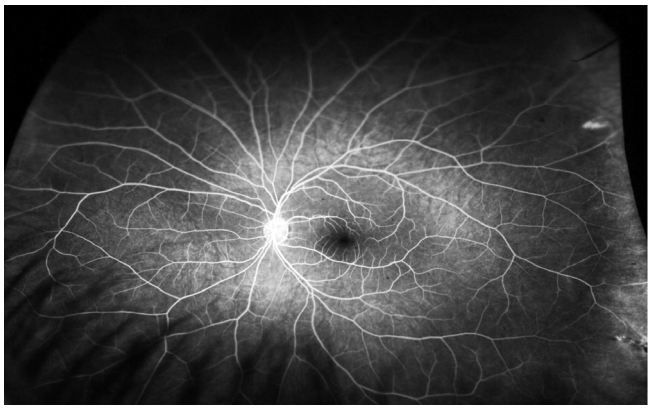

FIGURE 3. Ultra-widefield fluorescein angiography (FA) image of normal eye.

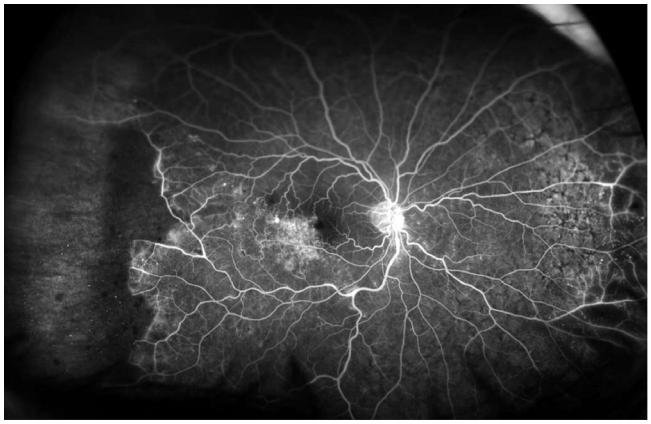

FIGURE 4. Ultra-wiedefield fluorescein angiogram of the eye after branch retinal vein occlusion with peripheral ischemia.

daily practice in the Department. Such examinations are essential for both correct diagnostics and treatment planning, particularly in case of patients with vascular diseases and retinal dystrophies. We have seen a considerable number of patients with pathologies of the central retina (accompanied by peripheral changes.) Were we to use standard imaging techniques, these pathologies would have probably been missed. The most important part of any fundus examination of vascular diseases is capillary dropout or nonperfusion and pathological neovascularisations in the retinal periphery (Figure 4).

We have estimated that such pathologies affect around 30-35% of patients. The exact number is subject to change, depending on the type of the disease we look at. Any information about vascular peripheral pathologies in diabetic retinopathy or retinal vein occlusions makes early therapeutic intervention possible and that is what gives better prognosis for the patient.

Autofluorescence imaging, which reflects retinal pigment epithelium activity, is helpful in diagnosing and monitoring progression in diseases such as AMD (age-related macular degeneration) and retinal dystrophies. We use this kind of imaging to evaluate any peripheral changes during therapeutic interventions and observing natural disease progression when no treatment options exist.

Predictions for the future

Since quite recently, commercial widefield OCT (optical coherent tomography) has started to evolve and first instruments are commercially available. OCT is a non-invasive imaging technique using low-coherence interferometry to obtain an *in vivo*, cross-sectional view of retinal layers.

OCT with widefield option will enhance visualization of macular disorders that spread behind standard scan widths and application of this technology to the retinal periphery would expand our knowledge of peripheral vitreoretinal pathologies.

These advancements in OCT image registration would probably have a positive impact on clinical as well as surgical care and future research into retinal diseases.

CONCLUSIONS

Although ultra-widefield technology has yet to become the standard in retinal disease diagnostics and management, there are many clinical events where it proves useful. Hence, it might be safely assumed that it is going to take a more prominent place in the clinical care of patients referred to the retinal specialists.

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