Clinical research with the rtx1™ Adaptive Optics retinal camera

Summary of published results in **age-related macular degeneration**

Dry AMD is the most common type of AMD, accounting for 90% of diagnosed cases. In this form of the disease, the breakdown of macular cells results in growing areas of geographic atrophy (GA). However, the progression is very slow and its detection usually takes months.

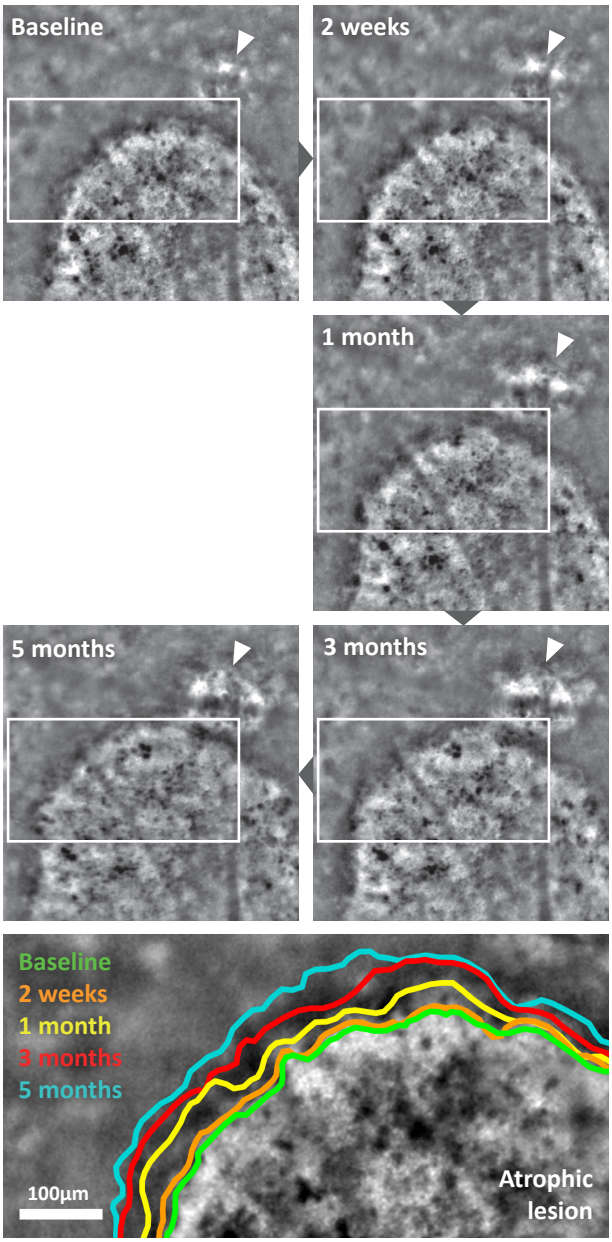
Thanks to Adaptive Optics (AO) technology, the rtx1™ enabled visualizing retinal changes in AMD patients at the cellular level. Moreover, since the rtx1 images are distortion-free, follow-up images could be aligned with high precision to study the dynamics of such changes over shorter time scales.

Clinical studies using the rtx1 have resulted in several new findings:

- In the early stages of AMD, rtx1 images showed that drusen cause changes in the contrast of the cone mosaic. Conventional drusen and reticular pseudodrusen were characterized by different reflectivity profiles[1–3].
- On eyes with dry AMD, GA borders and spared foveal areas appeared more detailed on rtx1 images than on SLO and autofluorescence (AF) images[4,5]. Time-lapse rtx1 imaging enabled tracking displacements of GA borders with micrometer precision, and progression could be detected in less than 1 month[4].
- The rtx1 also revealed a new candidate biomarker for dry AMD: the hyporeflective clumps (HRCs) which accumulate and migrate during disease progression. Although HRCs are invisible with other imaging techniques, the rtx1 enabled to observe their motion within a few days[1,4].
- In addition to dry AMD, the rtx1 is also being used in two clinical investigations of stem-cell therapies for the wet form of late-AMD. rtx1 images helped assessing the survival of the implanted RPE cells[6] in one investigation, and of cone cells[7] in the other.

> *The current technological level of robustness and the possibility to obtawin quantitative biomarkers already permits the integration of AO in large scale trials in AMD*
>
> Paques et al., *Progress in Retina and Eye Research*, 2018

> *Using AO NIR imaging, we could measure the progression of emerging atrophic areas at a relatively small temporal and spatial scale.*
>
> Gocho et al., *Investigative Ophthalmology & Visual Science*, 2013



Geographic atrophy progression monitored with the rtx1. Top: a nascent GA (arrowhead) is visibly growing. Bottom: enlarged part of the baseline image with the positions of the main GA border overlaid. Credit: Quinze-Vingts National Eye Hospital, Paris

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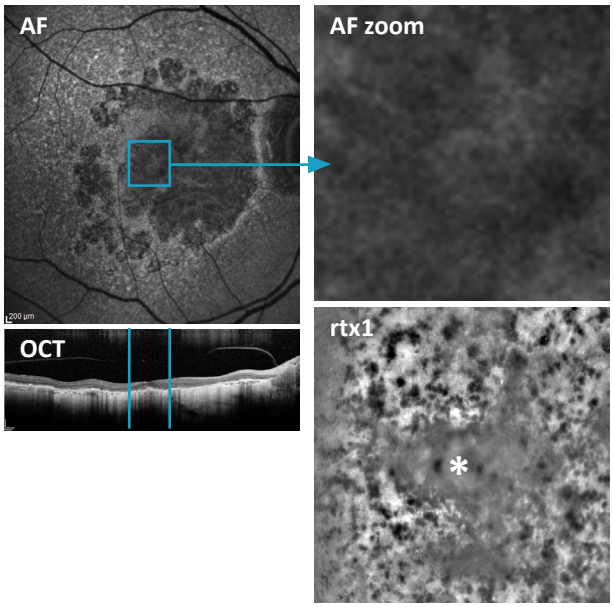
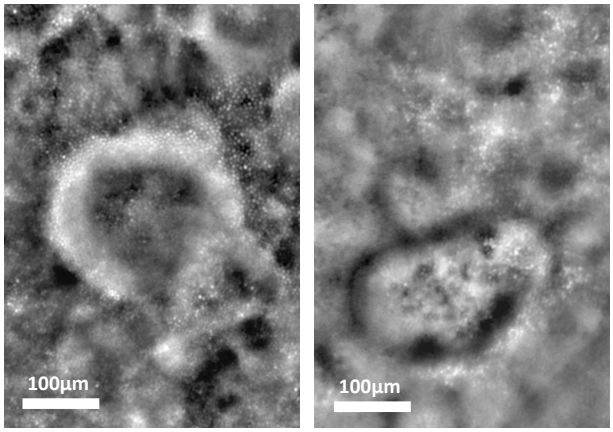
> *Preservation of functional cone photoreceptors could be demonstrated on en face AO images in areas of foveal sparing that highlights the utility of this imaging modality in the evaluation of emerging treatments for GA.*
>
> Querques et al., *Retina*, 2016



Multimodal imaging of foveal sparing in a dry AMD case. Compared with the AF image, the rtx1 image shows the spared area (*) more sharply and reveals HRCs in the arophic area (dark dots). Credit: Quinze-VIngts National Eye Hospital, Paris

> *Migration of HRCs is a highly dynamic process in AMD; it can indeed be detected over a timescale of days while atrophy progression is only detectable over a timescale of weeks.*
>
> Paques et al., Progress in Retina and Eye Research, 2018



rtx1 images of conventional drusen (left) with hyperreflective rings, and of pseudodrusen (right) with hyporeflective rings. Credit: Quinze-VIngts National Eye Hospital, Paris

> *The rtx1 allowed us to directly observe stem cell-derived RPE cells after their transplantation in a patient's retina. Thanks to the rtx1's microscopic resolution, we could verify that the mosaic arrangement of these cells was similar to that of natural RPE cells, and stable over time.*
>
> Dr. Seiji Takagi, Kobe City Eye Hispital, Japan, 2019

References

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www.imagine-eyes.com

18 rue Charles de Gaulle
91400 Orsay, FRANCE
+33 (0) 1 64 86 15 66
contact@imagine-eyes.com

(*) Quantifications based on adaptive optics retinal images have not been approved for clinical use.
The rtx1 is an approved medical device in the European Union (device class 2a) and in Japan. In the USA, the rtx1 has not received FDA clearance. It is an investigational device and requires Institutional Review Board (IRB) oversight for use in any research application. Further information is provided in the user's documentation.