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# *Intraoperative OCT in vitreoretinal surgery advantages and limits*



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## INTRODUCTION

- \* iOCT has only recently found its way into the operating theater to provide **real time feedback** through **image assisted** surgery.
- \* Although it still an emerging technology, numerous studies and reports have described its usefulness and value.

**The DISCOVER Study 3-Year Results**  
*Feasibility and Usefulness of Microscope-Integrated Intraoperative OCT during Ophthalmic Surgery*

Justin P. Ehlers, MD, Yalin C. Ahi, MD, Frank E. Poon, MD, Leif Gido, MD, William J. Harris, MD, PhD, Akhlesh Rajan, MD, Sunny Sharma, MD, Alan Yoon, MD, PCO, Bala Singh, MD, Prat K. Kaur, MD, Iain L. Rice, MD, Cameron Callahan, Allison White, M, Janel K. Swanson, MD

**Optical Coherence Tomography for Retinal Surgery: Perioperative Analysis to Real-Time Four-Dimensional Image-Guided Surgery**

Oliver H. J. Greenwald, Steven A. Lee, Christian V. Kridel, Joseph A. Spar, Michael J. Kelly, Joseph A. Spar, and Cynthia A. Spar

**The Prospective Intraoperative and Perioperative Ophthalmic Imaging with Optical Coherence Tomography (PIONEER) Study: 2-year Results**

Justin P. Ehlers<sup>1,2</sup>, William J. Harris<sup>1,2</sup>, Peter K. Kaur<sup>1,2</sup>, Jeff Gauth<sup>1</sup>, Rishi P. Singh<sup>1,2</sup>, Dan Palcoski<sup>1</sup>, and Sarah K. Swanson<sup>1,2</sup>

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**Microscope-integrated OCT Feasibility and Utility with the EnFocus System in the DISCOVER Study**

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**Integrative Advances for OCT-Guided Ophthalmic Surgery and Intraoperative OCT: Microscope Integration, Surgical Instrumentation, and Heads-Up Display Surgeon Feedback**

Justin P. Ehlers<sup>1,2</sup>, David H. Winkler<sup>1</sup>, David Taylor<sup>1</sup>, Alexander S. Hwang<sup>1</sup>, Andrew M. Pollack<sup>1</sup>, Yaelitz K. Top<sup>1,2,3</sup>

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**Determination of Feasibility and Utility of Microscope-integrated OCT During Ophthalmic Surgery: the DISCOVER Study RESCAN Results**

Justin P. Ehlers<sup>1,2</sup>, Jeff Gauth<sup>1</sup>, William J. Harris<sup>1,2</sup>, Peter K. Kaur<sup>1,2</sup>, Rishi P. Singh<sup>1,2</sup>, Richard Gava<sup>1</sup>, Jonathan Berger<sup>1</sup>, and Sarah K. Swanson<sup>1,2</sup>

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**Clinical Utility of Intraoperative Optical Coherence Tomography**

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## Recent history

- \* 1- Handheld system OCT: lack of stability and precision (motion artifacts)
- \* 2- Microscope mounted system: enhance stability and reproducibility
- \* 3- Integrated OCT (coaxial): real time imaging, guide surgical maneuvers

## Handheld system OCT

- \* Few companies: marketed and experimental
- \* Flexibility in the operating room
- \* **lack of stability and precision (motion artifacts)**



## Microscope mounted system

- \* Imaging over time intervals
- \* Control lateral and vertical deviations of the system and focus control with the microscope foot pedal
- \* Images before and at the end of the surgery rather than waiting to the patient seen in postop
- \* Advantage: Can be mounted on any microscope, instant decision making
- \* **Enhance stability and reproducibility**



## Integrated OCT (coaxial)

- \* Microscope integrated real time 2D scan
- \* Real-time cross sectional view of the surgical field to help an Instant decision making
- \* More information not necessarily enough to guide for 3 dimensional movements
- \* currently marketed by several companies
- \* Visualization on the screen or in the binocular

## Integrated OCT

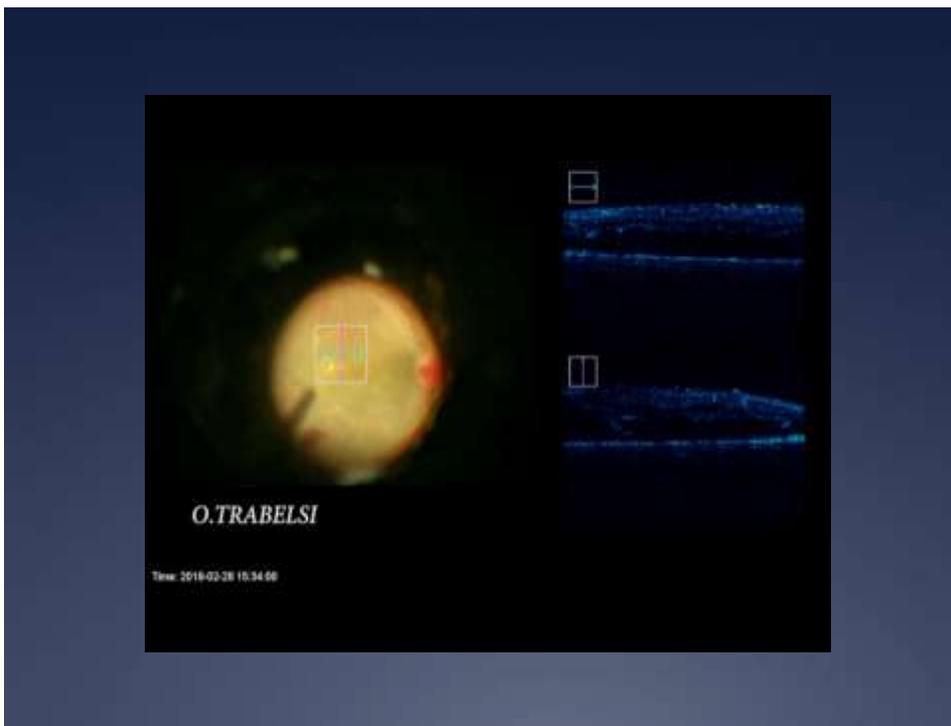
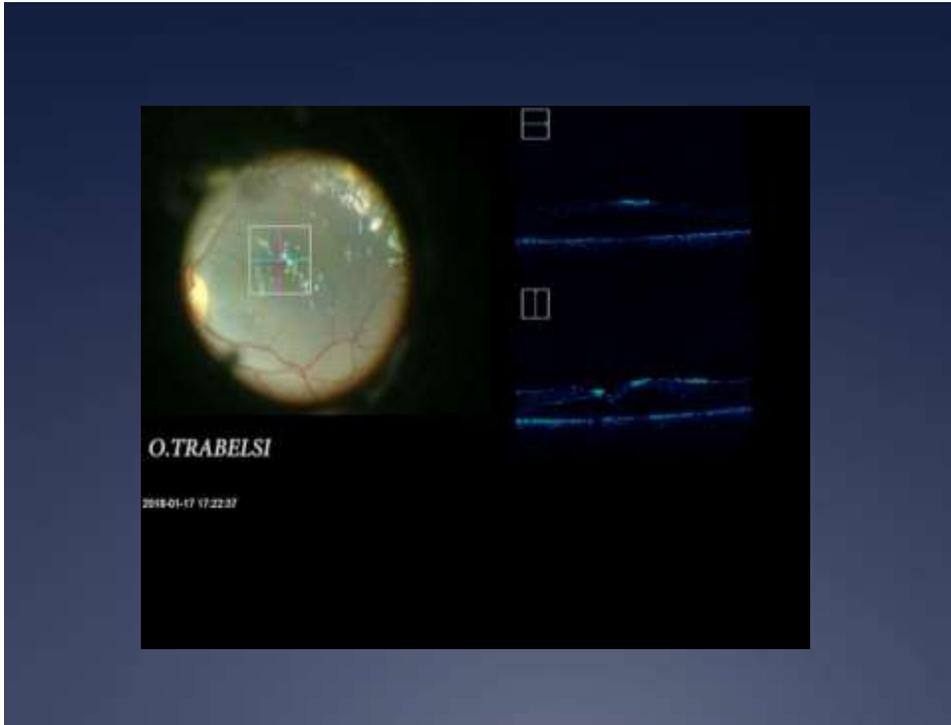


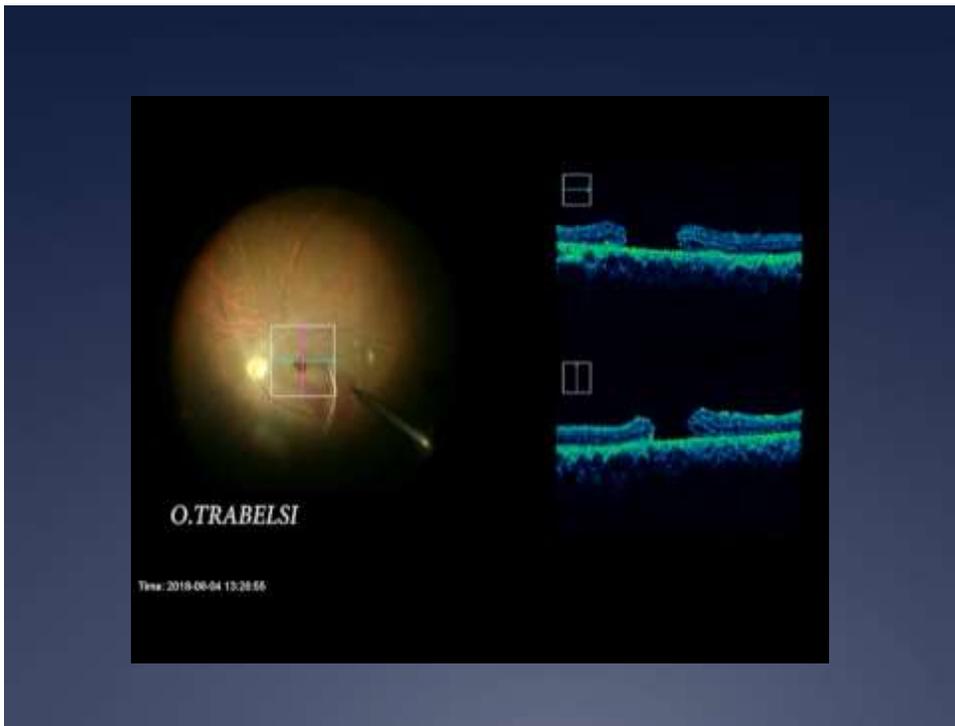
## Clinical applications

- \* Assess immediately the results of the surgery
- \* Complete removal of an ERM?
- \* ILM peel
- \* Macular hole: in case of failed surgeries the edge of previously peeled ILM can be visualized.
- \* Detection of subretinal fluid at the posterior pole, detection of PVR.
- \* Assess the macular status when preoperative evaluation is not possible.

## Drawbacks

- \* Targeting the OCT field of view to the area of interest (manual targeting)
- \* Visualization of the instrument and the underlying retina can be affected by the optical properties of surgical instruments (back shadowing)
- \* OCT compatible instruments may be a key component to the feasibility of real time image guided surgery with intraoperative OCT

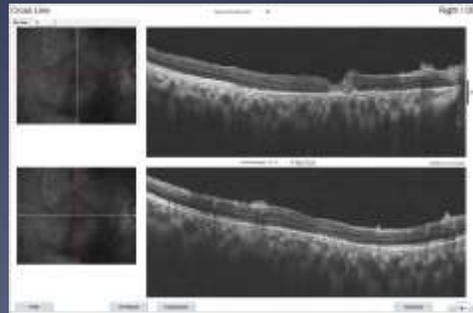




30 days



2 months



Clearly we are in the early stages of this technology

*What is the next step of iOCT ?*

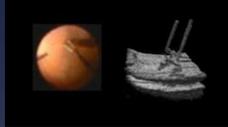
## Future needs and directions

- \* OCT compatible surgical instrumentation (back shadowing)
- \* Automated tracking and focus control (minimize surgeon burden for manual aiming)
- \* Software platforms: enhance speed and quality of image acquisition (3D)
- \* OCT-A ?

- \* By combining this together we should be able to see **interaction** between the **instruments** and the **retina** or instruments with beneath the retina
- \* Impact on emerging therapies, such as gene therapy and stem cell therapy.
- \* Targeted image-guided delivery with confirmatory imaging of optimal placement.



## The Future



- \* 4D MIOCT
- \* Heads-up augment reality (3D external screening) combined to iOCT
- \* Artificial reality in an immersive reality



## Conclusion

- \* With the availability of **MIOCT**, it's finally possible to have a real intraoperative **surgical assist**.
- \* Using this technology, we can achieve a greater understanding of the intraoperative retinal morphological changes and help prognosticate surgical outcomes more objectively.

*Thank you for your attention*



Sidi Bousaid TUNISIA



El JAM theater TUNISIA

*But ALSO*



Alexandria



Alexandria