ARVO JOURNALS | Search... All Journals | Advanced Search | SIGN IN

Current outcomes and future impact
Free webinar | March 31 | 8 – 9pm EDT

Abstract Issue 2016 Vol. 57, No. 12
2016 ARVO Annual Meeting
Seattle, Wash.
May 1-5, 2016
September 2016
Volume 57, Issue 12

OPEN ACCESS
ARVO Annual Meeting Abstract | September 2016

Monitoring of O_2 concentrations during Corneal Cross-Linking (CXL) by Phosphorescence Lifetime Imaging Microscopy (PLIM)

Rebecca M McQuaid; Michael C Mrochen; Ruslan Dmitriev; Dmitri Papkovski; Brian Vohnsen

Author Affiliations & Notes

Rebecca M McQuaid
Ophthalmology, Univ Coll Dublin/IROC Innocross, Dublin, Ireland

Michael C Mrochen
Ophthalmology, IROC Science AG, Zurich, Switzerland

Ruslan Dmitriev
School of Biochemistry and Cell Biology, University College Cork, Cork, Ireland

Dmitri Papkovski
School of Biochemistry and Cell Biology, University College Cork, Cork, Ireland

Brian Vohnsen
Ophthalmology, Univ Coll Dublin/IROC Innocross, Dublin, Ireland

Footnotes

Commercial Relationships **Rebecca McQuaid**, None; **Michael Mrochen**, None; **Ruslan Dmitriev**, None; **Dmitri Papkovski**, None; **Brian Vohnsen**, None

Support IRCSS EPSPG/2013/598

Investigative Ophthalmology & Visual Science September 2016, Vol.57, 2884. doi:

79 Views
0 Citations
View Metrics
Advertisement
SHARE TOOLS

Abstract

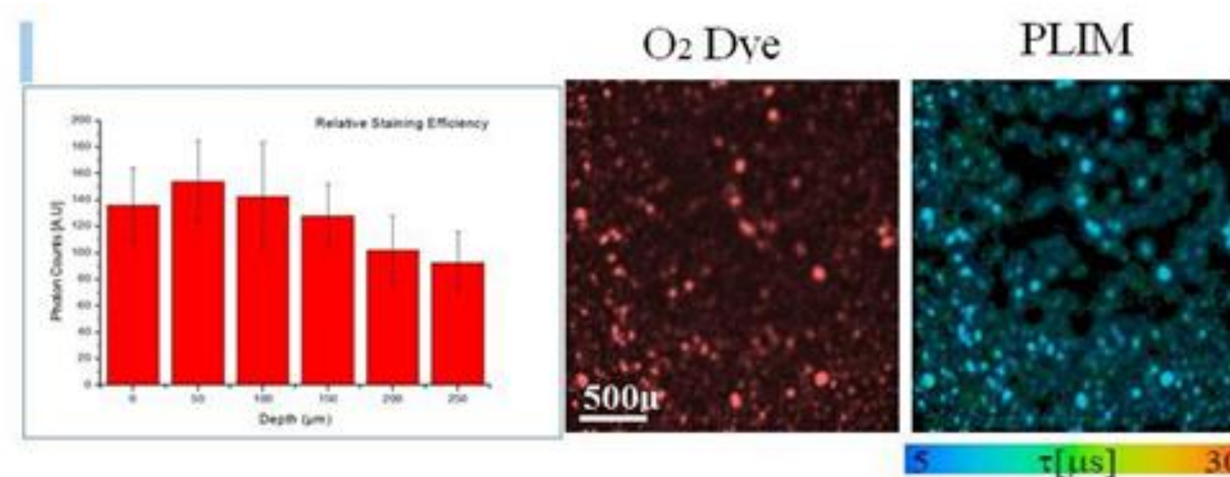
Purpose : The diffusion of riboflavin and oxygen is vital for efficient corneal cross-linking (CXL) with UV light. Previous studies found the biomechanical effect of CXL to be oxygen dependent. The purpose of this study is to investigate the role of O_2 and its distribution across the stroma before and during CXL through the use of phosphorescence based probes and imaging.

Methods : Porcine eyes were obtained from the local slaughterhouse 4 hours post mortem and kept at a temperature of 4°C. The epithelium was removed and the cornea was stained with a solution containing 0.5% riboflavin and infra-red emitting nanoparticles O_2 probe for 30 min to allow diffusion. The globe was then analysed at 37° C and 21% ambient O2 on the confocal upright PLIM microscope (Zeiss, Becker & Hickl GmbH) using 5x/0.25 Fluar objective, excitation at 488 nm and emission collected at 750-810 nm. The cornea was imaged over 10 minutes at depths of 0, 50, 100, 150 and 200 µm. The cross-linking was achieved through periodic 20-30 cycles illumination of cornea with UV-A LED light (7 mW/cm2) whilst imaging. Photon distributions and phosphorescence decay curves were analysed after measurement, from which lifetime values and O_2 concentrations were calculated and presented as 2D and 3D maps.

Results : We optimised staining with the O_2 probe and measurement conditions for the cornea, and performed proof-of-principle PLIM experiments before and after CXL. We observed efficient and uniform in-depth staining of the cornea allowing us to generate high-resolution O_2 maps and monitor O_2 dynamics during CXL. Previous PLIM results scanning in the Z-direction revealed little to no change in lifetime decays during UV illumination, suggesting axial scanning may be a quicker and more efficient method in quantifying O2 lifetimes during the CXL process.

Conclusions : The use of phosphorescent O_2 probes allows for efficient and a minimally-invasive method in measuring O_2 prior to, and during CXL. 2D and 3D maps of O_2 concentrations across the stroma during CXL will enable us to better understand the role of oxygen during CXL. Future work will focus on measurements under different O2 environments to verify the CXL effect with O_2 probes, and to investigate the suitability of O_2 PLIM method for future in-vivo use.

This is an abstract that was submitted for the 2016 ARVO Annual Meeting, held in Seattle, Wash., May 1-5, 2016.



View Original Download Slide

Nanoparticle staining of the cornea at depths up to 250µm (ambient conditions only)

This work is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License.

Copyright © 2015 Association for Research in Vision and Ophthalmology.