Molecular Imaging of the human retina by Raman Spectroscopy

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Abstract:
Objective: to develop a system for molecular imaging of human retina by coupling Raman Spectroscopy to a confocal Scanning Laser Ophthalmoscope (RS-cSLO).
Background: Retina is part of the Central Nervous System (CNS) and it can be easily assessed with photonic devices such as Optical Coherence Tomography (OCT) that offers a good in-vivo structural retinal image. In Multiple Sclerosis, OCT reveals Ganglion Cell Layer thinning that parallels brain atrophy. However, Inner Nuclear Layer thickening has been associated with inflammation and neurodegeneration. Molecular imaging may better and earlier discriminate these mechanisms since functional changes usually appear in an early phase of disease, a key period for neuroprotective drugs.

Design/Methods: we developed a prototype of RS-cSLO for measuring key molecules related with inflammation and neurodegeneration in human retina. It acquires molecular information of the macula in 5 minutes. After acquisition, the signal is processed using bioinformatics tools to identify retinal RS signature associated with biological processes and to discriminate subgroups of patients. We tested the test-retest variability of the RS from the retina and the skin from a group of healthy volintaries to address the reproducibility of RS-cSLO and its ability to discriminate tissues. Also, we obtained the RS from reference molecules (e.g. ethanol).

Results: The RS-cSLO was able to obtain the expected spectra from reference molecules (ethanol). Second, the obtained spectra were able to discriminate between tissues (retina vs. skin). Retina spectra from healthy controls showed high reproducibility between subjects (>95%) and along time (24h apart) (88.1%–96.5%) under strict acquisition conditions. No side effects reported were reported with the use of the RS-cSLO prototype.

Conclusions: Raman spectroscopy offer a technological opportunity to non-invasively address molecular changes of the CNS (retina) in vivo.

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Molecular information from CNS is critical for new drug development. We developed a Raman Spectrophotometer coupled to a confocal Scanning Laser Ophthalmoscope (RS-cSLO) for studying the "human retina as a window to the brain". This technology offers

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**Keyword (Complete):** Raman Spectroscopy ; Photonics ; Molecular imaging ; Retina
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