

Birefringent Tissues Imaging by *in-vivo* Confocal Microscopy and Polarization-sensitive Spectral Domain Optical Coherence Tomography

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1. Introduction

Currently, PS SD-OCT has been used in the imaging of the various birefringent tissues and materials. It can give us much information relative to the polarization characteristics of the sample; phase retardation, optic axis orientation, and etc. The PS-OCT imaging of birefringent tissues was compared with that of *in-vivo* confocal microscopy

2. Experiments

In this works, the differences between normal mouse muscles and Lewis lung carcinoma (LLC) cancer were investigated by PS SD-OCT system.[1] The sample tissues are normal muscle and LLC cancer around the chest of Ds red GFP mouse. PS-OCT imaging shows the presence of birefringence in normal mouse muscles along the depth. Phase retardation image at a certain depth is displayed in red. Cumulative fast axis orientation from backscattering position just below the top surface to an optical depth of about 200 μm was displayed in blue. However, the phase retardation and fast axis orientation images of LLC cancer were displayed in almost blue and green color, respectively. It means that the birefringence in the chest muscle has disappeared and was destructed by the LLC cancer. Some laterally organized layer structures in normal mouse muscles were shown in the reflectivity image, though they did not appear in the reflectivity image of LLC cancer. The difference between two sample tissues can be exactly revealed by the phase retardation and fast axis orientation images.

In order to compare with confocal microscopy images, reflection and fluorescence images of chest muscle and LLC cancer were obtained by a home-made reflection and fluorescence hybrid *in-vivo* confocal microscopy.[2] The cross-sectional reflection confocal images were reconstructed from three dimensional intensity image data. Although the penetration depth (110~ 150 μm) of confocal microscopy is lower than the proposed OCT system, the reflection confocal image of normal muscle has several parallel layers same as reflectivity image of OCT, while the reflection image of LLC cancer does not have any special structures. The difference between normal chest muscle and LLC cancer of GFP mouse was clearly revealed from fluorescence image compared with reflection image. The highly organized layers composed of a lot of fibrous structures, which can result in birefringence in the sample, while the fluorescence image of LLC cancer does not have these kinds of linear structures.

[1] Cheol Song, DaeGab Gweon: "Novel Polarization-sensitive Spectral Domain Optical Coherence Tomography using Single Camera Spectrometer", European Conference on Biomedical Optics 2009, Munich Germany, Proceedings of SPIE-OSA Vol.7372 73721T-1~7, Jun.14-18, 2009.

[2] MyoungKi Ahn, ByungSeon Chun, Cheol Song, and DaeGab Gweon: "Development of Reflection and Fluorescence Hybrid *in-vivo* confocal microscope," Focus on Microscopy 2009, Krakow Poland, p.271, Apr.5-8, 2009.