PROPAGATION OF POLARIZED LIGHT IN SKELETAL MUSCLE

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ABSTRACT

Skeletal muscle is a very important tissue in animals and humans. Optical polarization imaging is a non-invasive method to study biological tissues and provides unique polarization contrast. An imaging system was developed to acquire optical polarization-sensitive images in muscles. Both reflectance and transmittance images were studied and compared with those images in isotropic scattering media.

In reflectance measurements, 16 raw polarization images were acquired. The Stokes images, Mueller matrix images and degree of polarization (DOP) images were calculated. Polar decomposition algorithms were applied to derive polarization parameters. We also studied the effects of muscle stretching. The equi-intensity profiles in the polarization images of muscle showed very distinguished patterns which had a preference across the muscle fiber direction. The single and double scattering models in isotropic media were applied to compare with the experimental results in polystyrene solution. Mie scattering theory can not explain all the experimental results observed in muscle. Using a diffraction model, the unique features shown in the Mueller matrix and DOP images of muscle can be explained as the sarcomere diffraction effect.

In the transmittance measurement, we acquired polarization images in samples of different thicknesses. The polarization intensity patterns were analyzed, and the Mueller matrix images were calculated. The intensity decay curve, DOP values, and the polar decomposition parameters of the ballistic and scattering propagation regions were

calculated. The results show that polarized light propagation through skeletal muscle is affected by the scatters in muscle, the fibrous structure in tissue, and the diffraction effect from the sarcomere structure.

Further studies are necessary to investigate how the skeletal muscle structure affects the polarized light propagation, and how to calculate and remove the effect of the skin and fat tissue for *in vivo* measurements.