Study of the optical properties of laser propagation in brain tissue

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Abstract

Recent technology advancements in photonics have spurred prodigious progress toward the development of innovative methods and systems for clinical functional optical imaging, laser surgery, and phototherapy. That modern studying light penetration in biological tissues became very important in various medical applications. It is an essential factor required to resolve the optical dose in many diagnostic and therapeutic procedures. The development of optical biomedical methods and techniques has stimulated great interest in the study of optical properties of human tissues, which define the efficacy of tissue optical probing and light action on tissue and when are known (measured) give an opportunity to predict precise photon propagation trajectories and fluence rate distribution within irradiated tissues. The absorption and scattering properties of the inspected tissue control how deep the light will travel inside the tissue. However, these optical properties are highly dependent on the wavelength of the light source. In this paper, the light transmission through different regions of the head tissues was measured and analyzed and the optimal laser wavelength and power density required to reach different parts of the brain were determined using light (laser) with different wavelengths by comparing the fluence distribution, penetration depth, and laser-tissue-interaction mechanism within brain.

Keywords: Tissue optical properties; optical fluence rate; transcranial laser irradiation; optical transmittance; brain; diffuse reflectance.