

Public Abstract

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Title:Photoacoustic discrimination of viable and thermally coagulated blood for burn injury imaging

Early and accurate determination of burn depth is crucial to monitoring and treatment of the burn wound. One such treatment, surgical excision and grafting, involves removal of necrotic tissue from the burn wound and replacing it with healthy skin donated from another area of the body. We propose that a photoacoustically obtained depth profile of the burn wound, which delineates the boundary between necrotic tissue and viable tissue, would prove useful for this intervention.

A simplified model of a dermal burn wound can be described as a layer of necrotic tissue, containing thermally coagulated blood, atop a layer of inflamed tissue that is characterized by the presence of viable (non-coagulated) blood. Using optical spectroscopy and photoacoustic spectroscopy, we show that it is possible to discriminate between coagulated and non-coagulated blood using a dual-wavelength photoacoustic method and, therefore, discriminate between the two layer types. A blood vessel phantom study confirmed the feasibility of this dual-wavelength photoacoustic technique.

Finally, since little is known about the optical properties of thermally coagulated blood, we sought out to elucidate them. A novel photoacoustic method was used to derive the optical absorption coefficient of thermally coagulated blood over the wavelength range from 580 to 700 nm. Additionally, we performed a linear regression on the 580 to 700 nm absorption spectrum and extrapolated it out to 500 nm, creating a theoretical 500 to 700 nm absorption spectrum for thermally coagulated blood.

Our results have shown the clinical potential of photoacoustic burn depth determination and monitoring.