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In vivo noninvasive measurement of blood glucose by near-infrared diffuse-reflectance spectroscopy

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Abstract

This paper reports in situ noninvasive blood glucose monitoring by use of near-infrared (NIR) diffuse-reflectance spectroscopy. The NIR spectra of the human forearm were measured in vivo by using a pair of source and detector optical fibers separated by a distance of 0.65 mm on the skin surface. This optical geometry enables the selective measurement of dermis tissue spectra due to the skin's optical properties and reduces the interference noise arising from the stratum corneum. Oral glucose intake experiments were performed with six subjects (including a single subject with type I diabetes) whose NIR skin spectra were measured at the forearm. Partial least-squares regression (PLSR) analysis was carried out and calibration equations were obtained with each subject individually. Without exception among the six subjects, the regression coefficient vectors of their calibration models were similar to each other and had a positive peak at around 1600 nm, corresponding to the characteristic absorption peak of glucose. This result indicates that there is every possibility of glucose detection in skin tissue using our measurement system. We also found that there was a good correlation between the optically predicted values and the directly measured values of blood samples with individual subjects. The potential of noninvasive blood glucose monitoring using our methodology was demonstrated by the present study.

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