Resorbable optical fibers for monitoring physiological signals; a proof-of-concept validation

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Abstract

Development of optical quality bioresorbable fibers is an emerging area of study where researchers are trying to advance the field by assessing the suitability of these fibers for various biomedical applications. These types of fiber implants dissolve in the human body over a clinically relevant time scale eliminating the need for extraction surgeries. Most of the current non-invasive optical monitoring methods and external sensors are generally limited to superficial tissues and blood vessels without providing the details of deeper regions in the body. Current methods of interstitial physiological monitoring mainly rely on the insertion of probes or ultrasound catheters, and electrodes in the case of monitoring neural activity. These methods mainly suffer from size and invasiveness, limited biocompatibility, corrosion, or MRI interference and ultimately removal operations with associated costs and risks. The existing external imaging techniques such PET and CT are valuable tools in non-invasive monitoring of physiological parameters in deep tissues, but they do not provide continuous real-time information over extended periods.

Here, we investigate the capability of an in-house manufactured CaP glass based bioresorbable optical fiber, for real-time monitoring and recording of parameters such as blood flow and electrical signals, which can aid in intra-operative and post operative monitoring to track potential infections or the healing process. We conducted both ex-vivo and in vivo diffuse correlation spectroscopic studies using our fibers to measure blood flow and a preliminary trial to integrate a biocompatible electrode material on the fiber for electrical signal measurements. The results demonstrated the potential of CaP glass-based fiber-optic devices in future physiological monitoring applications which can be implanted inside the body without the need of an explant procedure.

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