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Abstract: Inaccuracies in intraoperative tumor localization and evaluation of surgical margin status result in suboptimal outcome of breast-conserving surgery (BCS). Optical imaging, in particular near-infrared fluorescence (NIRF) imaging, might reduce the frequency of positive surgical margins following BCS by providing the surgeon with a tool for pre- and intraoperative tumor localization in real-time. In the current study, the potential of NIRF-guided BCS is evaluated using tissue-simulating breast phantoms for reasons of standardization and training purposes. Breast phantoms with optical characteristics comparable to those of normal breast tissue were used to simulate breast conserving surgery. Tumor-simulating inclusions containing the fluorescent dye indocyanine green (ICG) were incorporated in the phantoms at predefined locations and imaged for pre- and intraoperative tumor localization, real-time NIRF-guided tumor resection, NIRF-guided evaluation on the extent of surgery, and postoperative assessment of surgical margins. A customized NIRF camera was used as a clinical prototype for imaging purposes. Breast phantoms containing tumor-simulating inclusions offer a simple, inexpensive, and versatile tool to simulate and evaluate intraoperative tumor imaging. The gelatinous phantoms have elastic
properties similar to human tissue and can be cut using conventional surgical instruments. Moreover, the phantoms contain hemoglobin and intralipid for mimicking absorption and scattering of photons, respectively, creating uniform optical properties similar to human breast tissue. The main drawback of NIRF imaging is the limited penetration depth of photons when propagating through tissue, which hinders (noninvasive) imaging of deep-seated tumors with epi-illumination strategies.