

Quantum Dot-Based Intraoperative Fluorescence-Guided Surgery Improves Negative Margin Rates in Head and Neck Squamous Cell Carcinoma

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Abstract

Achieving negative surgical margins in head and neck squamous cell carcinoma (HNSCC) is critical for local control but challenging due to microscopic tumor infiltration. We developed near-infrared-II (NIR-II) emitting quantum dots (QDs) conjugated to anti-EGFR antibodies for real-time tumor delineation. In a prospective phase I trial of 30 HNSCC patients, QD-guided surgery identified positive margins in 8 cases deemed negative by standard white-light visualization and frozen section analysis. The NIR-II fluorescence offered enhanced tissue penetration depth (3-5 mm) and tumor-to-background ratios (TBR > 5.0). This nanotechnology platform significantly reduces local recurrence risk through enhanced intraoperative visualization.

Keywords: quantum dots, NIR-II fluorescence, intraoperative imaging, head and neck cancer, surgical margins, EGFR targeting



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