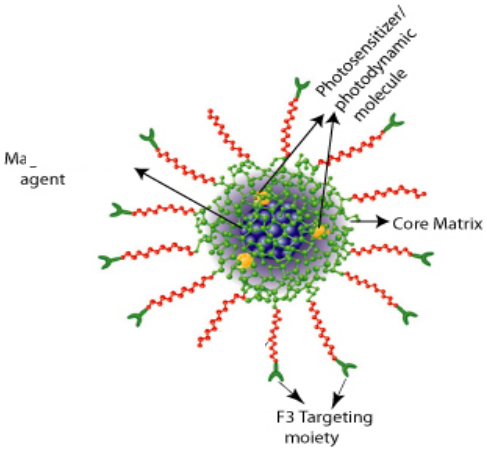
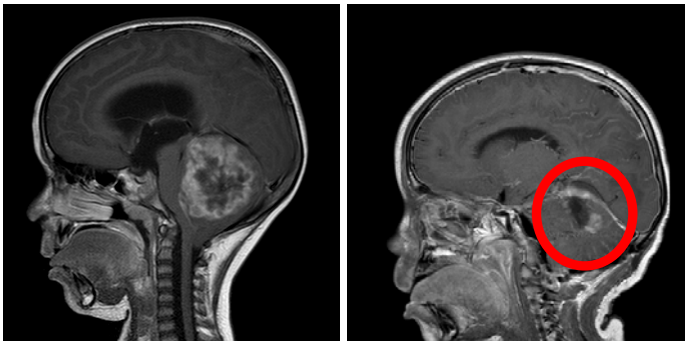
Nano-Assisted, Intraoperative Brain Tumor Therapy

Brain cancers are the most aggressive human cancers, and no single treatment has yet been found to arrest the fast growth of malignant gliomas. Moreover, the difficulty of seeing brain tumors at the time of surgery may often lead to an incomplete resection and requires taking patients back to the operating room for a secondary operation. The goal of this project by Dr. Raoul Kopelman from the University of Michigan is to develop targeted, multifunctional nanoparticles that provide real-time optical contrast for tumor margination during surgery and photodynamic therapy of residual cells to improve the survival rates of brain tumor patients.



The schematic on the left depicts a single nanoparticle designed to target tumors by attaching the homing F3 peptide to the surface (F3 moeity label) and encapsulating a visible dye plus a photosensitizer to observe the tumor with the naked eye and activate the photodynamic process (free radical scavenger).

The image on the left shows a brain tumor mass prior to surgery. The difficulty of seeing a tumor at the time of surgery often leads to an incomplete resection (bright tissue in center of red circle). Thus, the patient had to be admitted for a second surgery.



The dye-labeled nanoparticle (figure top left) can be administered intravenously and selectively targeted to brain tumors to optimize the ability of neurosurgeons to delineate neoplasm and healthy nervous tissue for precise surgical debulking. The same targeted nanoparticle also encapsulates photosensitizing agents that can be activated by visible light and thus eradicate residual tumor mass following surgical resection.

References/Publications

Koo YE, Fan W, Hah H, Xu H, Orringer D, Ross B, Rehemtulla A, Philbert MA, Kopelman R. Photonic explorers based on multifunctional nanoplatforms for biosensing and photodynamic therapy. *Appl Opt.* 2007 Apr 1;46(10):1924-30.

De Gao, Rodney R. Agayan, Hao Xu, Martin A. Philbert, and Raoul Kopelman. Nanoparticles for Two-photon Photodynamic Therapy in Living Cells. *Nano Lett.* 2006 November; 6(11): 2383–2386.