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# Development of a novel combined fluorescence and reflectance spectroscopy system for guiding high-grade glioma resections

A primary brain tumor is an abnormal growth of cells in brain tissue. Brain tumors are classified as either benign (not invading healthy tissue) or malignant (infiltrating and destroying healthy tissue), depending on their degree of malignancy and aggressiveness. Benign brain tumors grow slowly and will not invade and destroy surrounding tissue, but will grow as a solid encapsulated tumor. Benign tumors thus have a clear border and can be removed. Malignant brain tumors contain cancer cells, are usually rapidly growing and life-threatening. These tumors intend to spread into the nearby healthy brain tissue and may recur after treatment. Glioblastoma multiform (GBM) is an example of highly malignant brain tumors. The prognosis for patients with GBM is of high concern, as it is associated with fast growth. Without therapy, patients die within three months and with optimal therapy, have a mean survival of approximately 12 months. The main challenge in the therapy of this tumor is associated with its infiltrative growth and visual similarity of GBM to the surrounding brain tissue so that complete resection under white light, even in experienced hands, is between 13% and 20%.

Among all technologies and treatment algorithms employed in the treatment of this tumor type, intraoperative fluorescent tumor visualization has shown great promise. In this study, we aimed at developing a combined fluorescence/reflectance spectroscopy system that can assist the surgeon in distinguishing tissue types during brain tumor resection. The contrast agent used to provide the fluorescence contrast is 5-delta-aminolevulinic acid (ALA)-induced protoporphyrin IX (PpIX). The ALA is administered orally to the patient prior to surgery. Malignant glial tumor tissue will then build up a higher concentration of Protoporphyrin IX, providing a fluorescence peak at 635 nm following 405 nm light excitation. The primary goal is obviously to provide a signal with high sensitivity and specificity for malignant tissue. Successful performance evaluation of this instrument has been demonstrated by performing various tissue-equivalent phantom laboratory and clinical studies.

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