# Операционные микроскопы для интраоперационной флуоресцентной визуализации BLUE 400, YELLOW 560, INFRARED 800, FLOW 800

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# ZEISS Intraoperative Fluorescence Technologies

Discovering the previously unseen

Fluorescence is the property of atoms and molecules, so called fluorophores, to absorb light at a particular wavelength and to subsequently emit light of longer wavelength. Fluorescence microscopy can be based on autofluorescence or the addition of fluorescent dyes.[1,2] Under normal light fluorescent dyes might be invisible. But a surgical microscope with integrated fluorescence technology lights up the dye to visualize tumor tissue or blood vessels during surgery.

- **Tumor**
- **Vascular**
- **Reconstructive**

## Deeper insights. Greater control.

The first use of intraoperative fluorescence imaging in surgery dates back to 1948 when surgeons used intravenous fluorescein to enhance intracranial neoplasms during neurosurgery.[2,9] Since then, additional fluorescent agents have been used for a variety of surgical applications.[4,5,6,9] Intraoperative fluorescence imaging offers the benefits of high contrast and sensitivity, absence of ionizing radiation, ease of use, safety, and high specificity.[7,8,9] Compared with standard unaided vision using white light imaging, real-time fluorescence imaging is helpful in visualizing cancerous tissue and delineating tumor margins.[8] Moreover, improved visualization of the cancer can reduce damage to important normal structures such as nerves, blood vessels, ureters, and bile ducts.[9]

In challenging microsurgery, surgical visualization adjuncts are essential for making the right decisions at the right time. The Intraoperative Fluorescence Technologies[1] from ZEISS offer you the tools you need.

# Intraoperative visualization of fluorescence-stained structures in tumor surgery

## BLUE 400 from ZEISS

BLUE 400 from ZEISS supports intraoperative differentiation between diseased and healthy tissue. It was the only microscope integrated fluorescence module to prove its efficiency in a successfully conducted Phase III multi-center study.[2]

According to a 2015 study by Esteves et al., high-grade gliomas (grades III–IV) are the most common brain tumors in Europe, with an incidence of 3.13 per 100,000 residents. The extent of tumor resection is a major prognostic factor for survival.[3] Studies show that resection of at least 98% of the tumor tissue is required to significantly impact the survival rate. A randomized controlled trial (RCT) study by Stummer et al. in 2006 showed that the probability of complete resection of the tumor was significantly increased when using 5-ALA fluorescence (5-aminolevulinic acid) (65% vs. 37%, $p<0.0001$).[2]

We [...] published a medical economic study [...] to demonstrate that [by] using BLUE 400, we can improve outcome of the patients [...].

**Prof. Dr. Walter Stummer**Director and Head of the Department of Neurosurgery, University Hospital Münster, Germany

## ZEISS YELLOW 560

ZEISS YELLOW 560 is the first intraoperative fluorescence module[1] to highlight the fluorescence-stained structures while visualizing non-stained tissue in its natural-like color. It allows research activities with suitable fluorescence dyes.[1]

The benefit is that the tumor is resected in a better way because unaffected brain is visualized indirectly and you can preserve it.

**Prof. Dr. Karl-Michael Schebesch**Deputy Clinic Director, Clinic and Polyclinic for Neurosurgery, University Hospital Regensburg, Germany

# Intraoperative imaging of cerebral blood flow in vascular surgery

### ZEISS INFRARED 800

With **ZEISS INFRARED 800** it is possible to visualize sub-millimeter blood vessels.
Intraoperative imaging of cerebral blood flow is of particular interest in vascular neurosurgery. Fluorescence-assisted angiography using indocyanine green (ICG) allows for real-time qualitative assessment of vascular permeability or pathological vascular structures during surgery. As early as 2003, the results of a feasibility study by Raabe et al. revealed that ICG fluorescence angiography is useful in the assessment of aneurysms, dural fistulas, and in revascularization surgery.[10] Integrated into the surgical microscope, ICG angiography is a suitable technique for visualization and for assisting in the evaluation and interpretation of intraoperative blood flow in vessels with less than 1 mm in diameter. It assists in early detection of complications as well as reducing the risk of ischemic damage and the need for further postoperative intervention.[11]

### ZEISS FLOW 800

Using ZEISS INFRARED 800 video sequences, **ZEISS FLOW 800** offers a unique fluorescence application for the visual analysis of vascular blood flow. The information from the video sequences is compiled into visual maps, diagrams, or side-by-side images. This enables a detailed analysis of the fluorescence videos.
Simple imaging of vascular structures is often insufficient for the detection of hypo- or hyperperfusion; doing so requires quantitative analysis of the data.[12] Study results have shown that FLOW 800 analysis software provides valuable additional information for surgeons in intraoperative assessment of arterial patency and regional blood flow.[13-16]

# Intraoperative fluorescence imaging in reconstructive surgery

### ZEISS INFRARED 800

Typically used in free flap surgery, **INFRARED 800 from ZEISS** enables fluorescence-assisted assessment of blood flow after an anastomosis has been created and visualizes the vascular patency of the grafted tissue.
A 2012 study by Holzbach et al.[17] demonstrates that ICG fluorescence angiography is a useful, expeditious, and safe procedure in flap surgery, especially in intraoperative use. The findings of Mücke et al. show that FLOW 800 constitutes a reliable analysis tool for intraoperative flap perfusion monitoring,[18] as well as for intraoperative thrombosis detection.[19] A 2014 study by Yamamoto et al.[20] found that intraoperative ICG lymphography facilitates identification of lymphatic vessels and allows for accurate assessment of anastomoses.

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