Fluorescence Imaging with the Modular IMAGE1 S™ Camera Platform from KARL STORZ

For imaging with the fluorescent dye indocyanine green (ICG)*, KARL STORZ offers brilliant, laser-free FULL HD imaging of the vascular system, biliary tract, and lymphatic system. The NIR/ICG system is based on the IMAGE1 S™ camera platform.

- 5 mm telescope available
- Multidisciplinary applications, e.g., in general and visceral surgery, thoracic surgery, gynecology, urology, and reconstructive surgery
- Xenon-based technology (no laser safety measures necessary)
- Optimal illumination and contrast enhancement
- All-in-one solution for laparoscopic and open surgery with VITOM® II ICG
- Outstanding user-friendliness

*Please verify that the fluorescent dye indocyanine green is approved for the respective indication in your country.
The NIR/ICG System from KARL STORZ as a Modular System Solution for Diverse Applications

- Visualization of the bile duct anatomy
- Visualization of perfusion
  - Intraoperative perfusion assessment of colorectal anastomoses
  - Identification of ischemic area and vascular structures
- Application in liver surgery
  - Visualization of liver segments
  - Diagnosis of liver metastases and carcinoma
- Visualization of the lymph system
  - Identification of lymphatic vessels and lymph nodes
  - Lymphatic leakage
Visualization of the Gallbladder and Bile Ducts

Due to hepatobiliary excretion, ICG naturally collects in the gallbladder and bile ducts. This allows the rapid and reliable identification of the gallbladder and bile duct anatomy. Thanks to enhanced visualization of the biliary anatomy, cholecystectomy can be performed more quickly and with greater assurance.

- Allows a reliable differentiation between the cystic duct and common bile duct\(^1\)
- Intraoperative leaks displayed with ICG
- Shortened surgical duration with ICG compared to standard cholangiography\(^2\)

\(^1\) Boni et al., NIR/ICG Fluorescence Imaging in Laparoscopic Surgery, Doctor-to-Doctor Manual ENDO-PRESS\(^\circledast\), (ISBN 978-3-89756-934-8)

\(^2\) Dip et al., Cost analysis and effectiveness comparing the routine use of intraoperative fluorescent cholangiography with fluoroscopic cholangiogram in patients undergoing laparoscopic cholecystectomy, 2014

\(*\) SPECTRA A: Not for sale in the U.S.
Visualization of Perfusion

Perfusion assessment plays an important role in various medical disciplines. Ischemic areas can be easily identified by using the NIR/ICG system and administering ICG. This allows intraoperative action to be taken and reduces the duration of surgery.

- Rapid perfusion assessment of a planned resection zone as well as the subsequent anastomosis, e.g. in colon\(^3\) or esophageal resections and gastric bypass\(^4\)
- Perfusion assessment in flap plasty
- Visualization of liver segments

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\(^3\) Koh et al., Fluorescent Angiography Used to Evaluate the Perfusion Status of Anastomosis in Laparoscopic Anterior Resection, 2016

\(^4\) Boni et al., Clinical Applications of Indocyanine Green (ICG) Enhanced Fluorescence in Laparoscopic Surgery, 2015
Intraoperative Perfusion Assessment of Colorectal Anastomoses

Colorectal cancer is the third most common cancer in Germany. In most cases, radical surgery is the only way for total treatment. Good circulation in the area around the anastomosis is an important factor in the healing process of colorectal anastomoses. Anastomosis insufficiency can thus be prevented.

- The NIR/ICG system allows intraoperative perfusion assessment in real time, e.g., to delineate suitable resection zones
- Boni et al. showed that perfusion assessment can reduce the rate of anastomotic leakage

5 Robert Koch Institute, Berlin, Germany
6 Boni et al., Indocyanine green-enhanced fluorescence to assess bowel perfusion during laparoscopic colorectal resection, 2016
Primary liver cancer is the sixth most common cancer worldwide. Liver metastases are even 20 times more common than primary liver tumors. The NIR/ICG system with the fluorescent dye ICG offers the following advantages for liver surgery:

- ICG in conjunction with near infrared light allows the intraoperative visualization of metastases and carcinoma of the liver above or below the tissue surface.
- Possible to diagnose small metastases with millimeter accuracy.
- Easier to determine the extent of the resection.

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7 Cancer in Germany 2011/2012 (10th Edition), Robert Koch Institute, Berlin, Germany
8 Within accuracy of 1 cm depending on the tissue composition
9 Tummers et al., First experience on laparoscopic near-infrared fluorescence imaging of hepatic uveal melanoma metastases using indocyanine green, 2014
Liver Segmentectomy with the NIR/ICG System

The selective administration of ICG assists the identification of various liver segments during partial liver resection in both laparoscopic and open surgical procedures. Partial liver resection requires a sound knowledge of the existing course of the vessel and the boundaries of the individual segments while taking the diverse anatomical features of the blood vessels into consideration:

- The tumor is localized pre- or intraoperatively aided by CT, MRI and ultrasound techniques
- ICG is injected into the supply vessel of the segment
- Fluorescence allows easy differentiation of the affected segment from the adjacent non-fluorescing segments

ICG fluorescence can also help to detect bile leakage following liver segmentectomy or liver transplantation procedures.

Source: Niclas Kvarnström, M.D, Sahlgrenska University Hospital, Gothenburg, Sweden
Visualization of the Lymphatic System*

The reliable identification of the lymphatic system presents a challenge in oncological interventions. The use of NIR/ICG imaging can provide intraoperative visualization of the entire lymphatic system downstream of the tumor in real time. Nuclear medicine imaging procedures can thus be avoided.¹¹

- Non-radioactive method for lymph node visualization
- Detection rates compare favorably with established methods of lymph node visualization¹²
- Multidisciplinary use, e.g., in gynecology, urology, and general surgery

*(S)LN by means of the intradermal administration of ICG is already approved in Italy (breast cancer), Japan and Russia. Please inform yourself about the potential for the off-label use of ICG in your hospital / country.


¹² Imboden et al., A Comparison of Radiocolloid and Indocyanine Green Fluorescence Imaging, Sentinel Lymph Node Mapping in Patients with Cervical Cancer Undergoing Laparoscopic Surgery, 2015
Visualization of the Lymphatic System in Gynecology

In gynecology, the degree of tumor involvement in the sentinel lymph node (SLN) is of great importance. In breast cancer surgery, SLN detection with the radioactive tracer $^{99m}$Tc is the gold standard. In other areas of gynecological tumor surgery, its benefits in comparison to elective lymph node dissection is the subject of discussion. As a new, non-radioactive imaging technique, NIR imaging with ICG can provide a useful contribution to this field\textsuperscript{13}.

A study on SLN mapping of endometrial carcinoma yielded the following results ($^{99m}$Tc vs. ICG):

<table>
<thead>
<tr>
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<th>Radioactive Tracer $^{99m}$Tc</th>
<th>ICG</th>
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<tr>
<td></td>
<td>SLN detection rate</td>
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<tr>
<td></td>
<td>Bilateral SLN</td>
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<tr>
<td>Imboden et al.\textsuperscript{14}</td>
<td>83%</td>
<td>61%</td>
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<tr>
<td></td>
<td>Total SLN detection rate</td>
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<td></td>
<td>Bilateral SLN</td>
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<td></td>
<td>95.5%</td>
<td>95.5%</td>
</tr>
</tbody>
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\textsuperscript{13} Papadia et al., ICG-Enhanced Fluorescence-Guided SLN Mapping in Gynecological Malignancies, Doctor-to-Doctor Manual ENDO-PRESS\textsuperscript{®}, (ISBN 978-3-89756-932-4)

\textsuperscript{14} Imboden et al., A Comparison of Radiocolloid and Indocyanine Green Fluorescence Imaging, Sentinel Lymph Node Mapping in Patients with Cervical Cancer Undergoing Laparoscopic Surgery, 2015
Visualization of the Lymphatic System: Other Disciplines

Fluorescence-guided visualization of the lymphatic system with the NIR/ICG system from KARL STORZ is now used in many other disciplines. The following examples have already been described in literature:

- **Urology**\(^{15,16}\):
  - Prostate carcinoma
  - Penile carcinoma

- **General Surgery**\(^{17,18}\):
  - Colorectal carcinoma
  - Pancreatic carcinoma
  - Gastric carcinoma

\(^{15}\) Jeschke et al., Visualisation of the lymph node pathway in real time by laparoscopic radioisotope- and fluorescence-guided sentinel lymph node dissection in prostate cancer staging, 2012

\(^{16}\) Hruby et al., Fluorescence Guided Targeted Pelvic Lymph Node Dissection for intermediate and high risk prostate cancer, 2015

\(^{17}\) Boni et al., Clinical applications of indocyanine green (ICG) enhanced fluorescence in laparoscopic surgery, 2014

Fluorescence Imaging in Open Surgery with VITOM® II ICG

The VITOM® II ICG system from KARL STORZ also offers an optimal solution for fluorescence imaging in open surgery. VITOM® II ICG can be used with components of the NIR/ICG system.

- Enables open surgical and fluorescence-assisted interventions in various disciplines such as, for example, the visualization of lymphatic vessels and nodes as well as perfusion during flap grafts.
- Possible to integrate the VITOM® II ICG into the surgeon’s operating field by means of a holding arm.
- For optimal fluorescence results, the SPECTRA A* mode in the IMAGE1 S™ camera unit can be activated to achieve contrast enhancement.

* SPECTRA A: Not for sale in the U.S.
The KARL STORZ NIR/ICG system

1 **IMAGE1 S™**
   - Brilliant FULL HD image quality
   - ICG visualization in standard or SPECTRA A* mode

2 **NIR/ICG telescope and camera head**
   - 3-chip FULL HD camera head with high resolution and optimal NIR light sensitivity
   - Telescope for optimal fluorescence excitation and detection; can be used in white light and fluorescence mode
   - Telescopes in various lengths and diameters

3 **D-LIGHT P light source (Xenon light source)**
   - Optimal daylight spectrum; white light and fluorescence mode
   - No additional safety precautions (unlike laser)
   - With improved background visualization

4 **Foot switch**
   - Rapid switch between white light and fluorescence mode

5 **Autoclavable fiber optic light cable**
   - Optimal light transmission in white light and NIR spectrum

* SPECTRA A: Not for sale in the U.S.
It is recommended to check the suitability of the product for the intended procedure prior to use.