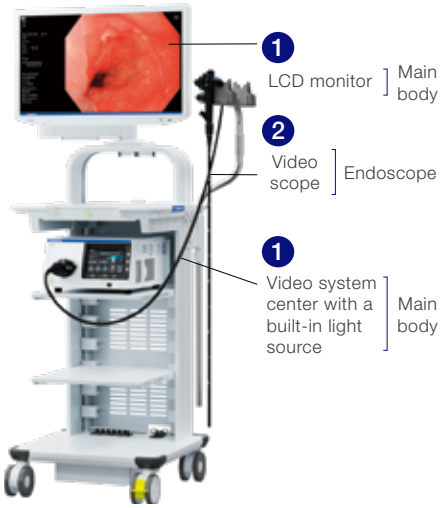
Structure and Components of Endoscopes

Outline of Gastrointestinal Endoscopy System

Current gastrointestinal endoscopes for examining the esophagus, stomach, and large and small intestines are mostly videoscopes. Videoscopes have an electronic image sensor attached to the distal tip of the instrument. A videoscope system consists of the following equipments.



1 Main body : LCD monitor Video system center

The video system center converts the electrical signals from an image sensor at the tip of a videoscope into video signals and displays them on an LCD monitor.

In addition to high-definition vision, the system supports various types of image processing including color enhancement and Narrow Band Imaging (NBI). The latest units are integrated with a light source and come equipped with an LED with a long life span. To improve color reproductivity, the system has adopted five-color LEDs supporting violet, blue, green, amber, and red. It also has an automatic dimming feature (automatically adjusts the brightness) and a pump that transmits water and air.

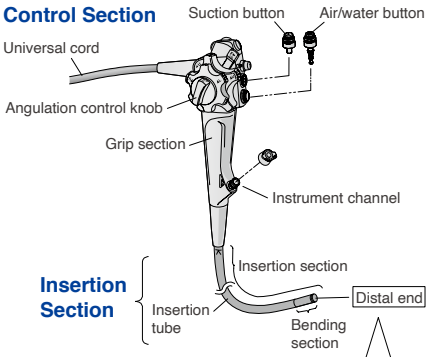
2 Endoscope

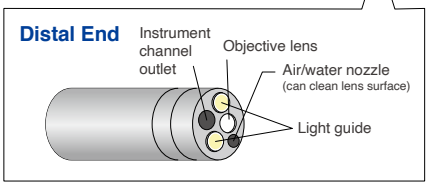
The endoscope has three parts: the control section, the insertion section, and the connector section.

● Control Section

The angulation knob on the control section is connected to the tip of the endoscope by a series of wires. By turning the angulation knob, the bending section at the distal end bends horizontally and vertically allowing for easier insertion into the body and the ability to view 360 degrees within body cavities.

The endoscope also contains buttons (valves) for feeding air or water and for applying suction. Covering the opening in the air/water valve will feed air into the organ being observed and will gently expand it for a better view. Depressing this valve will feed water through the endoscope to wash the viewing lens. Depressing the suction valve will allow the doctor to use the endoscope to suction any fluids which are obscuring a good view of the tissue. Endotherapy devices can be passed through the instrument channel for performing endoscopic biopsy and other treatments.



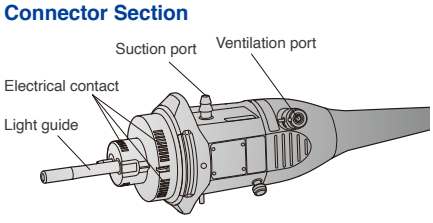


● Insertion Section

On the tip of the insertion section, there are four main parts: 1. Objective lens and image sensor, 2. Light guides that bring light from the light source through the endoscope, 3. Instrument channel outlet where endotherapy devices can be pushed in and out (also has a suction opening), 4. Nozzle for feeding water and air.

The objective lens is typically a super-wide-angle lens in order to visualize a large area of tissue at one time. In order to view tumor tissue in a more detailed manner, some endoscopes have an optical zoom feature. They also support high-definition video displays.

Light guide fiber bundles conduct light from the external light source through the endoscope to illuminate body cavities. Endotherapy devices are pushed in and out of the instrument channel for harvesting tissue (biopsy), removing tumors, cauterizing bleeding lesions, etc. The nozzle on the distal tip is used to clean the lens with water and expand body cavities by insufflating them with air.



● Connector Section

The connector section connects the endoscope with the video system center through the universal cord. Supply of air and water is also performed through this connection.

3 Peripheral

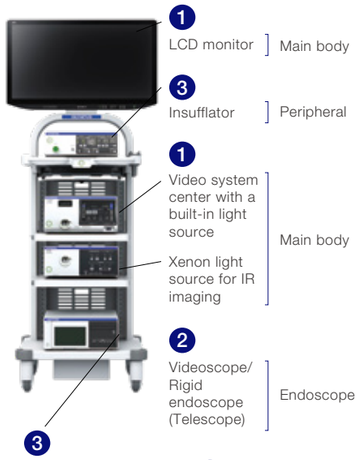
● Imaging Management Hub

Imaging management hub simplifies the process of recording, managing, and editing high-resolution endoscopic images (video and still images).

Imaging management hub

Outline of Surgical Endoscopy System

The following instruments are used in endoscopic surgery. As open surgery is gradually being replaced by endoscopic surgery, the sophistication of endosurgical device has increased.



1 Main body : LCD monitor
Video system center
Xenon light source for IR imaging

Surgical endoscopy systems include models that are compatible with 3D endoscopes, which make it easier to grasp depth, and models equipped with 4K monitors, which provide clear, high-definition images with greater detail. The video system center with a built-in light source serves as a processor that converts the electrical signals from the videoscope into video signals to display on an LCD monitor and functions as a light source that supplies light to the scope tip via the light guide cable. Some xenon light source devices enable infra-red (IR) observation.

2 Endoscope

● Videoscope

In general, videoscopes have a diameter of 5-10mm and a length of 300-370mm. Their tips contain a lens, a CCD image sensor, and light guide fiber bundles for bringing illumination into the body. Some models are straight, others have deflectable tips. The CCDs in Olympus endoscopes support high-definition imaging. Focusing is unnecessary due to their broad depth of field.

Surgical videoscope

● Rigid Endoscope (Telescope)

A wide variety of telescopes are used for various types of diagnosis and treatment. Uses in urology include transurethral prostatectomy and nephrectomy (kidney removal). Uses in ear, nose, and throat include viewing, diagnosing, and treating the eardrum, nasal cavity, and vocal cords, which is performed using a thin rigid endoscope. Rigid endoscopes are also used for myomectomy in gynecology and for viewing, diagnosing, and treating inside joint cavities in orthopedics.

Rigid endoscope (Telescope)

3 Peripherals

● Insufflator

The insufflator feeds carbon dioxide gas into the abdominal cavity in order to expand it and create a working space to perform surgery. A special insufflation needle (Veress needle) delivers the carbon dioxide gas to the peritoneal cavity. The insufflator monitors the pressure of the peritoneal cavity and automatically pumps in additional gas as needed to make up for gas that naturally leaks out during surgery.

Insufflator

● Imaging Management Hub

Imaging management hub simplifies the process of recording, managing, and editing high-resolution endoscopic images (video and still images).

Imaging management hub

● Trocar

Trocars are used to create an opening (portal) for passing endoscopic instrumentation into the body. The endoscope, forceps, electrosurgical knives, hemostatic/suturing equipment, etc., are then inserted through the trocar as needed for surgery. Olympus offers various types of trocars, such as ones that are available in diameters ranging from 5-15mm, ones that have an anti-slip balloon, and a threaded type. Currently, the most common trocars come with a sheath and are single-use.

Trocar

● Forceps

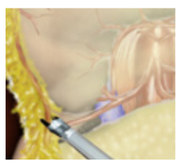
There are various kinds of forceps—such as grasping forceps that hold tissue and needles, dissecting forceps that mechanically separates tissue, scissor forceps for cutting tissue, etc.

Forceps

Tip of grasping forceps　Tip of dissecting forceps

● Hemostasis Clip

In endoscopic surgery, clips are often used to quickly close a blood vessel and stop bleeding that cannot be controlled by other means. The clips are held in a pistol-shaped clip applier. Clips are applied repeatedly like a stapler.



Hemostatic clip (image)

● Ultrasonic Energy Device

Ultrasonic devices for coagulation and cutting by converting electricity into ultrasonic vibrations. The heat is generated when the tip of the device (scissors) contacts the tissue and then cuts the tissue and causes coagulation (hemostasis).

Ultrasonic energy device

● High-Frequency Electrosurgical Device (Electrode)

Olympus has commercialized electrosurgical knives that use high-frequency currents as an energy source. These devices come in two types, monopolar with one electrode and bipolar with two electrodes. Bipolar knives in particular are capable of ablation for small lesions, for example. This minimizes the risk of thermal damage to surrounding tissue.

High-frequency electrosurgical device (Electrode)

● Fully-Integrated Bipolar/Ultrasonic Energy Devices

Combining the excellent hemostatic capabilities (controlling bleeding) of bipolar high-frequency energy with precise dissection of ultrasonic energy, the energy device can perform multiple tasks of vessel sealing, hemostasis, coagulation, incision, and dissection in one unit. The device meets surgeon's demands for superior medical effectiveness.

Bipolar & ultrasonic energy devices