LEARNING OBJECTIVES:

1. List the various types of flexible endoscopes.
2. Identify the various medical procedures that involve use of flexible endoscopes.

INTRODUCTION

Flexible endoscope reprocessing technicians need to know the various types of endoscopes used in their facility and be familiar with the procedures performed with those endoscopes. This knowledge will help ensure correct and thorough endoscope reprocessing. Each healthcare facility usually has several types of flexible endoscopes, which might be from different manufacturers. Never assume that all endoscopes are alike in design or in the manner in which they should be cleaned and otherwise reprocessed.

This chapter was developed to help the flexible endoscope reprocessing technician understand the various types of endoscopes, their uses, and their basic components.

TYPES OF FLEXIBLE ENDOSCOPES AND ENDOSCOPIC PROCEDURES

There are two primary types of endoscopes used for GI and bronchoscopy procedures:

- A **fiberscope** has a light source and an ocular eyepiece that enables the physician to view the internal organ or tissue. The fiberscope is the original endoscope design, which has been enhanced over time.

- A **videoscope** has a light source, a video processor, a printer, and a monitor to display the internal organ to the physician. The videoscope is a product of developing technologies and was designed in the early 1980s.

Many types of flexible endoscopes are in use today. It is important for the flexible endoscope reprocessing technician to be knowledgeable about this equipment and about the procedures in which it could be used. To better understand their work, flexible endoscope reprocessing technicians should be familiar with the common endoscopic procedures.

The physician who performs endoscopic procedures is called an endoscopist. Most endoscopic procedures are performed through natural openings of the respiratory or gastrointestinal tract. The esophagus (throat), stomach, and duodenum (small intestine) are the upper GI tract; the lower GI tract consists of the colon (large intestine) and the rectum.

The procedures endoscopists perform using **natural body openings** include the following:

- **Bronchoscopy**: A bronchoscope is used for this procedure. Chest clinicians visually examine and treat areas of the respiratory tract, including the trachea, main stem bronchi, and some of the small bronchi. Indications for bronchoscopy include hemoptyysis (coughing up blood), chronic cough, and lung cancer. They are not usually performed in
GI/endoscopy departments but rather in ORs. However, bronchoscopes are often reprocessed in the GI/endoscopy or respiratory therapy department.

- **Colonoscopy:** A colonoscope is used for this procedure, in which the endoscopist examines the lining of the colon for abnormalities. The colonoscope is inserted into the anus and then slowly advanced into the rectum and colon. This examination typically goes to the cecum and might involve intubation of the terminal ileum.

- **Esophageal gastroduodenoscopy (EGD):** This procedure, also known as panendoscopy, GI endoscopy, or upper endoscopy, is an examination of the esophagus, stomach, and duodenum.

- **Gastroscopy:** A gastroscope is used for this procedure, in which the endoscopist examines the esophagus and stomach.

- **Enteroscopy:** Enteroscopy is an examination of portions of the small intestines. This procedure allows the visualization of more of the small bowel than is possible with EGD and/or colonoscopy alone. One type of enteroscope has two single-use balloons at its tip and is pulled into the small intestine by alternately inflating and deflating opposing balloons.

- **Endoscopic ultrasound (EUS):** This procedure allows the endoscopist to examine layers of the digestive tract that are deeper than the surface of the mucosal lining. EUS is also used to study other organs that are near the gastrointestinal tract, including the lungs, liver, gall bladder, and pancreas. A special endoscope fitted with a small ultrasound device on the end is used to look inside the layers of the wall of the GI tract and visualize the surrounding organs, including the pancreas, liver, and gallbladder. The scope is inserted into the mouth or anus in the same manner as a conventional endoscope.

- **Capsule or virtual endoscopy:** A wireless camera mounted in a swallowed capsule is programmed to take multiple pictures as it traverses the digestive tract. The images, typically of the small intestine, are reviewed on a video monitor. Capsule endoscopy might be used as a diagnostic tool when intubation of the upper or lower GI tract is not feasible.

- **Endoscopic retrograde cholangiopancreatography (ERCP):** ERCP is a specialized technique used to study the liver, bile and/or pancreatic ducts, and gall bladder. Ducts are drainage routes; the drainage channels from the liver are called bile ducts or biliary ducts. The gall bladder drains into the cystic duct, which connects to the common bile duct. The pancreatic duct is the drainage channel from the pancreas. In this procedure, a special endoscope (an ERCP scope) with a side-mounted lens is used to facilitate passage of a catheter into the bile and pancreatic ducts. The duodenoscope is used to inject a contrast dye into the bile and pancreatic ducts, so that X-rays can be taken to reveal blockages, tumors, gallstones, and other problems. The scope also can be used to gather material for biopsies, remove stones or other obstructions, or install stents to open the ducts.

- **Proctoscopy/Sigmoidoscopy:** A proctoscopy or sigmoidoscopy (also called a flexible proctosigmoidoscopy or a proctosigmoidoscopy) is an examination of the inside of the rectum and the sigmoid colon. A sigmoidoscope is inserted through the anus for this procedure.
Endoscopic procedures that require surgical openings include the following:

- **Percutaneous endoscopic gastrostomy (PEG):** In this procedure, a flexible feeding tube is placed with the assistance of an endoscope through a small incision in the abdominal wall into the stomach. This procedure is performed in cases where oral ingestion of nourishment or medication is impossible.

- **Percutaneous endoscopic jejunostomy (PEJ):** In this procedure, a flexible feeding tube is placed with the assistance of an endoscope through a small incision in the abdominal wall into the stomach and pulled into the jejunum. As in the case of PEG, this procedure is performed in cases where oral ingestion of nourishment or medication is impossible.


**INDICATIONS FOR ENDOSCOPIC PROCEDURES**

**UPPER ENDOSCOPY (GI ENDOSCOPY, EGD)**

An upper endoscopy is performed to evaluate symptoms of persistent upper abdominal pain, nausea, vomiting, or difficulty swallowing. It is the best test for finding the cause of bleeding from the upper GI tract and is also more accurate than X-rays for detecting inflammation, ulcers, and tumors of the esophagus, stomach, and duodenum. The endoscopist might also use upper endoscopy to obtain small tissue samples for biopsy. A biopsy helps distinguish between benign and malignant (cancerous) tissues. Biopsies are taken for many reasons, and a doctor might order a biopsy even if cancer is not suspected (e.g., a biopsy can be taken to test for *Helicobacter pylori*, bacteria that can cause ulcers).

Upper endoscopy can also be used to perform a cytology (cell) test, in which a small brush is passed through the channel of the endoscope to collect cells for analysis. Other instruments can be passed through the endoscope to directly treat many abnormalities with little or no discomfort. For example, the doctor can stretch a narrow area (a stricture), detect and treat Barrett's esophagus (a possibly precancerous alteration in the esophageal lining), detect and biopsy gastrointestinal cancers, remove polyps (usually benign growths), treat bleeding (with cautery), and detect and treat symptoms of gastroesophageal reflux disease (GERD).


**ENTEROSCOPY**

Enteroscopy includes several types of procedures that allow a physician to look further into the small bowel (which is up to 25 feet long) than other methods mentioned here. A physician might use a longer conventional endoscope, a double-balloon endoscope, or a wireless capsule endoscope. Enteroscopy is primarily used to find the source of intestinal bleeding, but can also be used to find lesions and determine causes for nutritional malabsorption (inability to absorb nutrients from ingested foods).

An extended version of the conventional endoscope (a "push endoscope") can be used to study the upper part (about 40 inches [102 cm]) of the small intestine. A similar but longer instrument actually makes use of the normal digestive contractions of the small intestine to move the instrument further (up to 150 inches [381 cm]) into the small bowel. This procedure
takes more time than the “push” method, and the endoscopist still might not be able to see the entire small intestine.

In capsule endoscopy, the patient swallows a capsule that is about the size of a large vitamin pill. The capsule contains tiny video cameras, a light source, batteries, a radio transmitter, and an antenna. The capsule transmits the images to a recording device worn around the patient's waist. When complete, the recording is downloaded to a computer, which displays it on a screen. The capsule is disposable and usually takes eight hours to move through the digestive system, after which it is passed harmlessly in a bowel movement. Capsule endoscopy does not require sedation and is painless. Capsule endoscopy can be used to diagnose hidden GI bleeding, Crohn's disease, celiac disease and other malabsorption problems, tumors (benign and malignant), vascular malformations, medication injury, and, to a lesser extent, esophageal disease. Currently, capsule endoscopy cannot be used for biopsying tissue or for treating any conditions. For more information on capsule endoscopy, see the ASGE patient brochure, “Understanding Capsule Endoscopy,” at http://www.asge.org/patients/patients.aspx?id=390.

Double-balloon enteroscopy is a method of examining the inside of sections of the small intestine that cannot be reached by other techniques. In this procedure, the endoscopist uses a high-resolution video endoscope with latex balloons attached at the tips; the balloons can be inflated and deflated with air from a pressure-controlled pump system. A sequence of inflation and deflation cycles allows the endoscope to be advanced further into the small intestine than is possible with a conventional endoscope. The double-balloon endoscope is inserted into the mouth or the anus. With this technique, the endoscopist can perform biopsies, remove polyps, and investigate gastrointestinal bleeding, Crohn's disease, unexplained diarrhea, pancreaticobiliary disease (disease of the pancreatic and bile ducts), and other conditions. For more information, see the Boston Medical website at http://bmc.org/gastroenterology/procedurespreparations.htm.

COLONOSCOPY

Colonoscopy is performed to visualize the lining of the large intestine and rectum. The colonoscope is connected to a video monitor that the doctor watches while performing the test. Various miniaturized tools can be inserted through the scope to help the doctor obtain samples (biopsies) of the colon and to perform maneuvers to diagnose or treat conditions. Colonoscopy can be used to detect and remove polyps and to detect and sometimes treat rectal bleeding, fissures, strictures, fistulas, foreign bodies, Crohn's disease, and colorectal cancer. For more information on colonoscopy, see the ASGE patient brochure, “Understanding Colonoscopy,” at http://www.asge.org/patients/patients.aspx?id=7838.

SIGMOIDOSCOPY

Sigmoidoscopy, or flexible sigmoidoscopy, lets the physician examine the lining of the rectum and a portion of the colon. In this procedure, only the lower third of the colon can be evaluated. Various miniaturized tools can be inserted through the scope to help the doctor obtain samples (biopsies) of the colon and to perform maneuvers to diagnose or treat conditions. Flexible sigmoidoscopy can be used to detect and remove polyps and to detect and sometimes treat rectal bleeding, fissures, strictures, fistulas, foreign bodies, colorectal cancer, and benign and malignant lesions. Flexible sigmoidoscopy is not a substitute for total colonoscopy when it is indicated. Finding a new, abnormally growing polyp during sigmoidoscopy, for example, is an indication for a colonoscopy to search for additional polyps or cancer. For more information on sigmoidoscopy, see the ASGE patient brochure, “Understanding Flexible Sigmoidoscopy,” at http://www.asge.org/patients/patients.aspx?id=384.
ENDOSCOPIC RETROGRADE CHOLANGIOPANCREATOGRAPHY

Endoscopic retrograde cholangiopancreatography (ERCP) is a specialized technique used to study and treat problems of the liver, pancreas, and, on occasion, the gallbladder. To reach the small passageways, known as ducts, that connect these organs, a side-viewing endoscope called a duodenoscope is passed through the mouth, beyond the stomach, and into the small intestine. A thin tube is then inserted through the duodenoscope into the common bile duct and pancreatic duct connecting the liver and pancreas to the intestine. A contrast material (dye) is injected through the tube and flows into the liver and pancreas, outlining those ducts as X-rays are taken. The X-rays can show narrowing or blockages in the ducts that could be caused by cancer, gallstones, or other abnormalities. During the test, a small brush or biopsy forceps can be put through the duodenoscope to remove cells for study under a microscope. Tubes known as stents might be placed during ERCP and left in the ducts of choice to allow for better drainage. ERCP can be used to diagnose biliary colic, jaundice, elevated liver enzymes, cholangitis (inflammation of a bile duct), pancreatitis (inflammation of the pancreas), and bile-duct (biliary) obstruction caused by gallstones (choledocholithiasis) or cancer. ERCP can be used to treat gallstones, malignant and benign biliary strictures, cholangitis, pancreatic cancer, and pancreatitis. For more information on ERCP, see the ASGE patient brochure, “Understanding ERCP,” at http://www.asge.org/patients/patients.aspx?id=386.

ENDOSCOPIC ULTRASOUND

An endoscopic ultrasound (EUS) is performed with a flexible endoscope that has a small ultrasound device built into it that can be used to see the lining of the esophagus, stomach, small intestine, or colon. The ultrasound component produces sound waves that create visual images of the digestive tract that extend beyond the inner surface lining, providing more detailed pictures of the anatomy of the digestive tract. Endoscopic ultrasound examinations (also called endoluminal endosonography) can be performed through the mouth or through the anus. EUS can be used to evaluate an abnormality below the surface, such as a growth detected by a prior endoscopy or by X-ray. Because EUS allows the endoscopist to examine through the layers of the surface of the GI tract, the growth can be seen in more detail, which can help the doctor determine its nature and decide on the best treatment. EUS can also be used to diagnose diseases of the pancreas, bile duct, and gallbladder when other tests are inconclusive, and EUS can be used to determine the stage of cancers as well. Tissue samples can be obtained and certain therapies (such as the removal of certain cysts or aspiration of lymph nodes) can be performed with EUS guidance. For more information on EUS, see the ASGE patient education brochure, “Understanding EUS (Endoscopic Ultrasonography),” at http://www.asge.org/patients/patients.aspx?id=380.

PERCUTANEOUS ENDOSCOPIC GASTROSTOMY

Percutaneous endoscopic gastrostomy, or PEG, is a procedure in which an endoscope assists in the placement of a flexible feeding tube through the abdominal wall and into the stomach. The PEG procedure is for patients who have difficulty swallowing, problems with their appetite, or an inability to take enough nutrition through the mouth. It allows nutrition, fluids, and/or medications to be put directly into the stomach, bypassing the mouth and esophagus. In this procedure, the endoscopist uses an endoscope to guide the creation of a small opening through the skin of the abdomen and directly into the stomach, allowing the doctor to place and secure a feeding tube in the stomach. A PEG does not prevent a patient from eating or drinking, but, depending on the patient’s medical condition and situation, the doctor might decide to limit or completely prohibit eating or drinking by the patient. PEG tubes can last for months or years. However, because they can break down or become clogged over extended periods of time, they might need to be replaced. The doctor can remove or replace a tube without sedatives or anesthesia, although he
or she might opt to use sedation and endoscopy in some cases. PEG sites close quickly once the tube is removed, so accidental dislodgment requires immediate attention. For more information on PEG, see the ASGE patient education brochure, “Percutaneous Endoscopic Gastrostomy (PEG),” at [http://www.asge.org/patients/patients.aspx?id=394](http://www.asge.org/patients/patients.aspx?id=394).

**ENDOSCOPE STRUCTURE**

The endoscope is a complex medical device, comprising many intricate parts. Despite the variety of flexible endoscope models, all endoscopes have certain components in common.

![Figure 5-1 — Basic endoscope design](image)

The **umbilical (universal) cord**, which extends from the control body, connects to the light source via the light guide connector. This section conducts light through the shaft and transmits the image from the distal lens through the optic system (Figure 5-1). In addition, in some endoscopes, the umbilical cord contains internal channels (e.g., suction channels or air/water channels) that initiate at the light guide connector.

The **control body or section** is a general term that describes the main control area where the endoscopist holds and manipulates the endoscope. The control body contains important functional components, such as the lens (fiberoptic only), electrical switches, and angulation controls necessary to activate and operate the various functions of the endoscope. The control body also contains the instrument port, and, where applicable, the suction and air/water cylinders for the respective control valves (Figures 5-1 and 5-2). Even a slight impact to the control body can damage internal functions, allowing fluid to enter directly into that space. Impact to the control body frequently occurs as a result of stacking endoscopes in sinks and on countertops, during transport to and from procedures, during reprocessing, and as a result of storing endoscopes in cabinets of insufficient size.

The **insertion tube** extends from the control body to the distal end of the endoscope (Figure 5-1). Its design packs several individual components into the smallest area possible to minimize its outer diameter without damaging the more fragile components, such as the fiberoptic...
bundles. Fiberoptic bundles carry light through the instrument and disperse it evenly across the instrument’s field of view through the light guide lens. Each glass fiber is smaller than a human hair, with a diameter of 10 to 15 microns (µ). By comparison, a red blood cell is about 5 µ in diameter.

The distal-most portion of the insertion tube can be angulated (bent into a curve) under the control of the endoscopist. This deflection portion is known as the **bending section**. (See Figures 5-1 and 5.2.)

Avoidable damage to the insertion tube and bending section typically occurs when endoscopes are transported together with sharp accessories; when they are tightly coiled in transport containers, in sinks, or on countertops; and when they are stacked during transport to and from reprocessing areas. Cluttered reprocessing areas, cramped storage cabinets, and proximity to sharp instruments all contribute to damage to the insertion tube and bending section. Damage to biopsy/suction channels often results from improper or forceful passage of accessories and from tight coiling of the scope.

**Figure 5-2 — Flexible endoscope angulation system**

In the **flexible endoscope angulation system** (Figure 5-2), angulation knobs control deflection of the distal tip by means of angulation wires. The distal tip also contains the most delicate and crucial functions of the endoscope (Figures 5-3 and 5-4). This system manipulates the bending section of the scope for insertion and viewing.

As seen in Figure 5-3, there is a series of pulleys and wires or gear and chain system that connects to the angle wires. These wires are very strong (braided stainless steel) and extend from the control body all the way to the bending section at the insertion tip (distal end). The wires work in combination with one another and permit the up-and-down and side-to-side angulation of the tip. (Integrated Medical Systems and Educational Dimensions, 2015)

The **charge couple device (CCD)**, commonly known as the scope camera, is placed behind the objective lens of most endoscopes. The objective lens focuses light on the CCD, which is an image sensor that sends a continuous stream of images back to the video processor for display on a video monitor. It is very important that the objective lens and CCD unit be well sealed to prevent condensation from fogging the image and to protect the imaging system from damage if fluid were to accidentally enter the instrument.
The small channels that carry air and water through the insertion tube connect to the air/water nozzle at the distal tip of the instrument. The channel used for biopsy and suction exits close to the objective lens. The position of the biopsy channel relative to the objective lens determines how the accessories appear as they enter the visual field (Figures 5-3 and 5-5).

**Figure 5-3 — Distal end of endoscope, showing the location of objective and light guide lenses and internal channels**

**Figure 5-4 — Close-up of distal end of flexible endoscope**
The biopsy and suction channels are part of the same system inside the scope. The biopsy channel is a straight, flexible tube running from the insertion tip to the control body. The suction channel runs from the control body to the light guide connector. The suction and biopsy channels are joined in the control body and are controlled by the suction valve controls. (See Figure 5-5.) Not all scopes have a biopsy/suction channel system; for example, some small-diameter specialty scopes do not have this system.

The air/water channels are very thin and flexible. They run from the light guide connector to the insertion tip. Although air and water flow through separate tubes, they are controlled by the same valve on the control body. Air and water exit the scope at the distal end through the air/water nozzles, which direct the flow over the objective lens. Most small-diameter scopes do not have air/water capability.

Some flexible endoscopes, such as duodenoscopes and some endoscopic ultrasound scopes, are equipped with an elevator (also called a forceps raiser), which is located at the end of the insertion tip. This channel is used to deflect accessories passed through the biopsy channel. The elevator itself is a small metal arm at the biopsy port opening that is attached to a wire that runs inside the insertion tube, connects to a control lever on the control body, and operates much like the angulation system controls. The forceps-raising function is most commonly found on duodenoscopes and endoscopic ultrasound scopes. (Integrated Medical Systems and Educational Dimensions, 2015)

Except for the electrical video connections, the entire outer surface of a flexible scope is chemical- and fluid-resistant. Any seams between parts are sealed by O-rings, and a standard colonoscope might contain over forty of these O-rings. The chemical- and fluid-resistant coatings on the flexible tubes are themselves flexible, and some parts of the scope are sealed with epoxy. The ends of the bending rubber are sealed with silk or nylon braid and then
covered with epoxy. Caps or covers are provided to seal the electrical video connections against fluid. The end result is a device that, when undamaged, can be immersed completely in water or cleaning/disinfecting fluid. Consequently, the instrument can be reprocessed over and over again. (Integrated Medical Systems and Educational Dimensions, 2015)

Figure 5-6 — Elevator in duodenoscope

Figure 5-7 — Elevator in duodenoscope

Internal channels extend from the light guide connector to the distal end of the endoscope. Some endoscopes contain an additional channel called the auxiliary water channel or forward water jet (Figure 5-8). The endoscopist uses this channel to further clear debris or material from the mucosal surface in order to improve visualization of the tissue. Figure 5-9 illustrates the structure of a bronchoscope.
In order for the endoscopist to see inside the body, flexible endoscopes have a light transmission mechanism for imaging. Usually, the light enters the scope at the light guide connector, through the light guide prong. Inside the scope, light travels from the light guide prong to the distal end of the insertion tube through a series of fiberoptic light bundles. These are very thin, delicate glass rods that transmit the light. At the tip of the scope, the light is emitted through the light guide lenses, which distribute the light across the visual field.

The light cannot be adjusted; all adjustments are made manually on the light source or they can be adjusted automatically using the video cart system. It is important to prevent damage to the fiberoptic bundles because the more the bundles are damaged, the less light is transmitted. Practices such as tightly coiling the scope, placing heavy items on top of the scope, or even stacking scopes should be avoided to prevent damage to the light bundles.
Because of their complexity, endoscopes should be routinely inspected. According to AORN (2015), “visual inspection of flexible endoscopes, endoscope accessories and equipment helps to identify structural damage, when and where the damage occurred, what caused the damage, and how to prevent further damage. Loss of function and gross soil that may affect further processing and patient outcomes can also be identified during visual inspection.” Therefore, everyone who handles flexible endoscopes should visually inspect the scope at the following times:

- Before it is used
- During the procedure
- After completion of the procedure
- Before cleaning
- Immediately after cleaning
- Before and after high-level disinfection

If any damage is found, the scope should be removed from service and referred for repair.

**SUMMARY**

Flexible endoscope reprocessing technicians should be familiar with the various flexible scopes in use within the facility, their structure and function, and their indications for use. Each type of endoscope has its own anatomy, and different cleaning procedures might be required. Effective reprocessing of flexible endoscopes depends on an understanding of the type of endoscope and how it functions.

**REFERENCES**


Please click on the link below to go to the quiz.

https://www.spdceus.com/modules/second/gi/module_6_quiz.htm