Surgical Instruments and Specialty Devices – Part II

LAPAROSCOPIC INSTRUMENTS

Laparoscopy is a surgical procedure performed through very small incisions in the abdomen, using specialized instruments. A very thin instrument called a laparoscope is used, and it gives the surgeon an exceptionally clear view, on a TV monitor, of the inside of the abdominal cavity. Laparoscopic surgery is much safer than open surgery, and patients recover more quickly.

Laparoscopic surgery is also called:

- **Minimally invasive surgery**, because the surgery is performed through the smallest possible incisions.
- **Belly button surgery**, because the laparoscope used for abdominal surgery is often inserted through a small incision near the belly button, also called the umbilicus or navel.
- **Band-aid surgery**, because the incisions for laparoscopy are so small that they can be covered with adhesive bandage strips.
- **Endoscopic surgery**, because the instrument used for minimally invasive procedures on parts of the body other than the abdomen is called an endoscope.

The term laparoscopy is used when this type of surgery is performed in the abdomen; it’s called arthroscopy when performed in a joint and endoscopy when done through a natural opening in the body, such as the mouth.

Single-Incision Lap Surgery (SILS™) is a new medical innovation that takes the benefits of general laparoscopic surgery one step further. The SILS™ procedure has the following advantages:

- It eliminates the multiple incisions associated with traditional laparoscopic surgery, which can leave visible scars at all sites of entry. In contrast, the SILS™ procedure is accomplished with a single small 20 mm incision through the belly button.
- In addition to potentially reducing scar visibility, the SILS™ technique also might eliminate the wound pain associated with the multiple points of entry required by standard laparoscopic surgery.
- Finally, patients might benefit from a shortened recovery time because the single incision in the belly button means that surgeons can avoid cutting through multiple muscles to reach the problem site.

The medical technology that makes the surgery possible is just as important as the surgery itself. In performing the SILS™ procedure, surgeons use a specialized device called the SILS Port. This is a soft and flexible instrument that is inserted into the belly button, and it allows surgeons to use up to three laparoscopic devices simultaneously during common surgeries, such as gallbladder surgery.
NOTES® is another new type of surgery. NOTES® is the acronym for Natural Orifice Transluminal Endoscopic Surgery, which involves performing surgery through natural body openings (e.g., transoral [throat], transvaginal, transanal) rather than creating new surgical openings. According to the American Society for Gastrointestinal Endoscopy: “As an example, in natural orifice surgery the gallbladder might be removed through the mouth. The doctor would insert a tube down the esophagus, make a small incision in the stomach wall to gain access to the abdominal peritoneal cavity and take the gallbladder out by the same route. Potential advantages of the NOTES® technique include reduced post-operative pain, shortened recovery times, and improved cosmesis (lack of surgical incision scars).” (ASGE, 2010)

Laparoscopic instrumentation is constantly changing as new instruments are developed to facilitate procedures. After cleaning, they must be carefully inspected for cleanliness and functionality according to the manufacturer’s instructions.

The general inspection procedure is as follows:

- Ensure that the handle is working and that the jaws can open and close.
- For an instrument with a rotating jaw, ensure that the jaw rotates.
- Visually inspect the insulation for integrity.
- Make sure that the slid lock graspers are working.
- Check for debris in the hinges of working tips.
- Make sure that any instruments with trumpet valves (which have been disassembled for cleaning) have been properly reassembled.

Laparoscopic instruments can be insulated (Figure 9-23) or non-insulated (Figure 9-24).

Figure 9-23 — Insulated laparoscopic instrument
For insulated instruments, all of the insulation, down to the instrument tip, must be visually inspected, first using a magnifying lamp, for cracks, tears, and shrinkage. The insulation should be inspected where it joins the metal jaws. There should not be any space between the jaws and the insulation covering nor any damage to the insulation. If there is any shrinkage of the insulation (from wear and tear or damage), missing insulation, or damaged insulation, the instrument should be removed and sent for repair. Some manufacturers recommend pulling back on the insulation; if it slides back, the instrument should be sent for re-insulation.

Insulated instruments must be checked with an insulation tester, also called a “lap tester” (Figures 9-26 and 9-27), each time they are used. At present, there are three methods of testing insulation: reusable insulation testers, single-use insulation testers (which are usually sterile and which are used to test the insulation in the OR just before the instruments are used), and a continuous monitoring system (which monitors the instruments throughout the surgical procedure for insulation failure and which necessitate use of the specific company's laparoscopic instruments).
Damaged insulation poses a serious threat to the safety of the patient and the surgeon. If the insulation is cracked or nicked, electricity can arc through the insulation and burn the patient’s tissue or organs, which are usually out of the surgeon’s view. If the insulation on the handle is damaged, the surgeon could receive an electrical shock. The testing of each insulated instrument should be documented (e.g., on a log form). Documentation is needed because of the legal implications of an instrument with failed insulation being used on a patient; the documentation should be saved for the period of time recommended by the facility’s legal advisor.

Laparoscopic instruments should be carefully inspected to ensure that there is no debris in the jaws, that inserts are clean, and that all clean-out ports or luer connections are clean. In addition, it should be verified that tips approximate, scissors cut, and needle holders are functional. Laparoscopic scissors should not be tested with a latex product. They should be tested by cutting through a single layer of facial tissue; the scissors should cut through smoothly. All moving parts of the instrument, including stopcocks, must also be inspected, and ports should be checked to ensure that they are clear of debris.

There are three basic types of laparoscopic handles:

- Rotating handles with cautery connections
- Insulated handles with cautery connections
- Handles with ratches

For multi-part laparoscopic instruments, the handles should be inspected to ensure that they are of the correct type. The handles can be insulated or non-insulated; some have a monopolar connector for electrocautery; some have ratched handles; some have rotating jaws; and other design features can differ. It is critical to assemble the instrument with the correct handle and insert. Handles should be tested to ensure that the jaws open and close. If the instrument has a rotating jaw, the jaw should be checked to ensure that it rotates completely. For an instrument with a slide lock grasper, the grasper should be checked to ensure that it is working and that the metal connecting pin is not loose or missing. Some laparoscopic scissors are used with sterile single-use disposable tips, which are applied in the OR.
Many laparoscopic instruments must be disassembled for cleaning, so all parts must be checked to ensure that they have been correctly reassembled. Laparoscopic instruments should be reassembled for sterilization only if it is specified by the manufacturer. Some laparoscopic instruments cannot be reassembled for sterilization; some can be reassembled for steam sterilization, but not for other sterilization processes. The instrument manufacturer’s instructions for reassembly and sterilization should always be followed.

Figure 9-28 — Laparoscopic handle (plastic with rotation, insulated, with MANHES style ratchet and connection pin for monopolar coagulation)

Figure 9-29 — Laparoscopic instrument jaws
ENDOSCOPIC EQUIPMENT

The use of endoscopic equipment continues to increase. Many procedures that at one time required a stay in the hospital are performed on an out-patient basis and the patient goes home the same day. An endoscope is “a lighted optical instrument used to get a deep look inside the body and examine organs such as the throat or esophagus. . . .” Specialized endoscopes are named depending on where they are intended to look. Examples include: cystoscope (bladder), nephroscope (kidney), bronchoscope (bronchi), laryngoscope (larynx + the voice box), otoscope (ear), arthroscope (joint), laparoscope (abdomen), and gastrointestinal endoscopes (http://www.MedicineNet.com).

There are three types of endoscopic scopes: rigid, flexible, and semi-rigid. Associated equipment includes fiberoptic light cables, cameras, and minimally invasive surgery (MIS) instruments. It is important to handle these delicate and expensive instruments and devices carefully. When endoscopic instruments are prepared for sterilization, they should be separated inside a specialty container to prevent damage. Instruments with jaws that can remain open should be placed in the set with the jaws in the open position to facilitate the sterilizing agent (sterilant) reaching all surfaces of the instrument.

Figure 9-31 — Laparoscope

Endoscopes, whether rigid, flexible, or semi-rigid, should never be placed beneath other instruments. Special containers should be used to keep rigid and semi-rigid operative scopes in place during sterilization and transport. Some manufacturers of rigid scopes provide scope sleeves. The endoscope manufacturer’s IFU should be consulted to verify that protective sleeves should remain on the scope during sterilization. Rigid endoscopes should be separated
from trocars and other instruments that could damage the endoscope’s optical lens (eyepiece). The manufacturer's instructions for inspection, testing, and sterilization should be followed.

**Figure 9-32 — Rigid scope with protective sleeve (off for sterilization)**

**RIGID ENDOSCOPY**

Rigid endoscopes include such equipment as arthroscopes, hysteroscopes, resectoscopes, laparoscopes, and cystoscopes. Rigid endoscopes are much easier to clean than flexible endoscopes.


A laparoscope is an instrument through which structures within the abdomen and pelvis can be seen. A small surgical incision (cut) is made in the abdominal wall to permit the laparoscope to enter the abdomen or pelvis. A diversity of tubes can be pushed through the same incision or other small incisions permitting the introduction of probes and other instruments. In this way, a number of surgical procedures can be performed without the need for a large surgical incision.

Laparoscope comes from two Greek words. The first is lapara, which means “the soft parts of the body between the rib margins and hips,” or, more simply, the “flank or loin.” The other Greek root is skopein, which means “to see or view or examine.” Skopein has become “scope” in English.

A rigid scope has four basic components:

- An optical element (the telescope)
- An objective lens
- An eyepiece
- A light post

The optical element of a rigid endoscope is called the telescope. The most expensive and delicate part of the instrument, the telescope provides light (through fiberoptics) and images to the surgeon. The objective lens is located at the distal part (patient end) of the scope. The objective lens determines the viewing angle, which can be forward, oblique, retrograde, or lateral. The light post is where the fiberoptic light cord is attached to provide a power source for illumination. An adapter is sometimes needed for the specific light cord to attach to the scope. It is important to ensure that the correct adapter is provided inside the set (if applicable); however, the adapter should not be on the light post for sterilization. The eyepiece remains outside the
patient. The surgeon can view through the eyepiece directly or, most commonly, the eyepiece is connected to a camera so that the images can be viewed on a video monitor.

![Figure 9-33 — Components of a rigid scope](image)

It is important to note that as the diameter of the telescope decreases, its fragility can increase because of fracturing or misalignment of the smaller glass rods. Rigid endoscopes should not be bent or flexed. Rigid endoscopes are available in many lengths, diameters, and visual fields.

An endoscope should always be labeled accurately by manufacturer, service (e.g., GYN), size (e.g., 10 mm), and visual field (e.g., 0, 30, 45 degrees) (Figure 9-34). There are various ways to identify the scope angle of the visual field. One way is to visually identify the angle. Some manufacturers place identification bands on the scope to indicate the angle (Figure 9-35).

![Figure 9-34 — Scope at left is 0 degrees (scope angle of the visual field), scope in the middle is 30 degrees, and scope at right is 45 degrees](image)
Rigid scopes are available with different viewing angles:
- 120 degree or retrograde, for viewing backward
- 90 degree and 70 degree, for lateral viewing
- 45 degree
- 30 degree
- 12 degree, for forward oblique views
- 0 degree, for forward viewing.

The angle of the lens used is determined by the position of the structure to be viewed.

Because there are no moving parts in a rigid scope, virtually all problems are caused by mishandling or improper reprocessing. After a surgical procedure has been completed and the rigid endoscope has been properly decontaminated, all areas of the endoscope must be inspected for scratches, dents, burns, and any other visible damage. The endoscope must also be checked for visual clarity. Some of the newer rigid endoscopes cannot be tested for visual acuity unless they are attached to a camera. The endoscope manufacturer should be consulted for the recommended method of testing the endoscope. If the endoscope can be tested, there are several ways to perform the test. The first is to hold the tip of the endoscope about 3 inches (7.6 mm) above a non-glare, printed, white surface (e.g., a count sheet). The tip of the endoscope is moved progressively closer until it is approximately one-quarter of an inch (0.6 cm) away from the surface. The second way is to hold the endoscope up to a light source and look to see if the image is cloudy or distorted. A third way is to use a rigid endoscope tester (Figure 9-36). A fourth way is to hook up the scope to a power source and observe for clarity.
Regardless of the method of inspection, the image should be crisp and clear. A cloudy, discolored, or hazy image can be caused by improper cleaning, disinfectant residue, a cracked or broken lens, the presence of internal moisture, or external damage to the shaft. Certain disinfectants can cause a yellowish discoloration of lenses. If the lenses seem too cloudy and cleaning them with the solution recommended by the endoscope manufacturer does not clear them, the endoscope will have to be sent for repair.

Rigid endoscopes require the use of **fiberoptic light cables** attached to a light source (Figure 9-37); light is needed to visualize the surgical site. Fiberoptic light cables are filled with numerous thin glass rods to direct the light, so they are very delicate. The cables must be checked for broken rods, which can be done by simply holding one end of the cable up to the ceiling light and looking at the other end of the cable. If the cable is in good condition, a bright light will be seen. If the cable has been damaged and some of the glass rods are broken, numerous black dots will be noticed (Figure 9-38). If there are enough black dots to obstruct 15% to 30% of the viewing surface, the light is limited and the cable needs to be replaced. If there is any question, the light cable should be checked with a light source. Some fiberoptic cables are transparent to allow verification of the condition of the cable.
Figure 9-38 — Black dots at the end of a fiberoptic light cable, indicating damage

The cable manufacturer’s instructions for cleaning, inspection, assembly, and sterilization should be followed. Again, light cables should never be tightly coiled because the glass rods inside can be broken; the coil should not be less than 8 inches (20.3 cm) in diameter. The cables should never be placed beneath surgical instruments, because they could be damaged (Figure 9-39). If cables are packaged with a specific endoscope (telescope), care must be taken to ensure that the cable has the correct adapter (fitting) for that scope.

Figure 9-39 — Damage to fiberoptic cord caused by placing heavy instruments on top

Cameras are used in conjunction with rigid endoscopes to enable the surgeon to see the images on a screen and perform the surgery while the instruments are inside the body. Some endoscopes have the camera in the tip. It is essential to handle the cameras with extreme care during transport, cleaning, and sterilization. Particular attention should be paid to the lens, which should be free of water, spots, and defects. Many different systems are available. The type of camera should always be indicated on the package label, including such information as the manufacturer and the number of chips (e.g., three chips). It should be verified that the rigid endoscope and light cord are compatible with the camera. The camera cable should be inspected for soil and nicks or other damage; if soil or damage is present, the cable should not be used. Soaking caps should be applied before sterilization; otherwise, fluids could enter the cable and cause additional damage. The cables should be inspected for nicks or breaks; if any nicks or breaks are found, the camera should be sent for repair. Damage to the shielding on the cables can cause interference on the screen in the form of snow or flickering.
Care must be taken in the sterilization of endoscopic equipment. Many of the newer rigid endoscopes can be steam sterilized, but some still require low-temperature sterilization. The endoscope manufacturer’s instructions for sterilization should be followed.

**Scope warmers** are devices that pre-warm endoscopes to body temperature, keeping them fog-free during the surgical procedure.

**Trocars** are used to create an opening into the patient to permit passage of the scope, which provides light inside the body cavity. Both single-use and reusable trocars are available. The trocar has two components, an obturator and a cannula (Figure 9-42). The fiberoptic light cord is attached to the rigid scope, providing light to the surgeon. Trocars must be inspected carefully for defects, burs, and damage. Special training in the inspection of reusable trocars is recommended because special attention must be paid to the fit of the obturator. At some facilities, trocars are used only once and then sent to a surgical instrument company for sharpening.
FLEXIBLE ENDOCOPES

Flexible endoscopes are much more challenging to clean than rigid endoscopes, because they have numerous moving parts and small channels. When flexible endoscopes are reprocessed, the manufacturer’s instructions for inspection, leak testing, and sterilization or high-level disinfection must be followed carefully. Flexible endoscopes can be checked for functionality by looking at the tip of the endoscope to make sure that it has proper movement and checking the covering of the endoscope for cracks or defects. Before the endoscope is sterilized or high-level disinfected, it should be inspected for cleanliness and functionality using lighted magnification.

For duodenoscopes, it is important to ensure that the elevator mechanism located at the distal tip is thoroughly clean and free of all visible debris. The visual inspection should be performed both with the elevator in the “open/raised” position and with the elevator in the “closed/lowered” position. A lighted magnifying glass should be used to ensure that all debris has been removed.

Because of the sophistication of these devices, only those employees who have been thoroughly trained, with competencies verified, should process them. For more information about flexible endoscopes, see Chapter 5 and the textbook *The Basics of Flexible Endoscope Reprocessing* (Chobin, 2016).
OPERATING ENDOSCOPES

Operating endoscopes are equipped with irrigation and suction channels as well as channels for inserting special instruments (e.g., biopsy forceps to obtain tissue samples). Equipped with these additional features, endoscopes generally do not exceed approximately half an inch (14 mm) in diameter. The thinnest endoscopes, such as those used in pediatric surgery, measure only 0.07 inches (1.9 mm) in diameter. Depending on its medical application, an endoscope might be as much as 90 inches (230 cm) long or more.

HYSTEROSCOPES AND CYSTOSCOPES

Hysteroscopy is the inspection of the uterine cavity by endoscope, with access through the cervix. It allows for the diagnosis of intrauterine pathology and serves as a method of surgical intervention (operative hysteroscopy). A hysteroscope is an endoscope that carries optical and light channels or fibers. It is introduced in a sheath that provides an inflow and outflow channel for insufflations of the uterine cavity. In addition, an operative channel might be present to introduce scissors, graspers, or biopsy instruments. A hysteroscopic resectoscope is similar to a transurethral resectoscope and allows entry of an electric loop to shave off tissue (e.g., to remove a fibroid, a noncancerous growth). (Nouri, et al., 2010)

Cystoscopy is endoscopy of the urinary bladder via the urethra. It is carried out with a cystoscope. The urethra is the tube that carries urine from the bladder to the outside of the body. The cystoscope has lenses like a telescope or microscope. These lenses let the physician focus on the inner surfaces of the urinary tract. Some cystoscopes use optical fibers (flexible glass fibers) that carry an image from the tip of the instrument to a viewing piece at the other end. Depending on the application (e.g., pediatric, adult), cystoscopes range in size from the thickness of a pencil up to approximately 9 mm in diameter and have a light at the tip. Many cystoscopes have extra tubes to guide other instruments for surgical procedures to treat urinary problems. There are two main types of cystoscopy — flexible and rigid — which differ in the flexibility of the cystoscope. Any nicks or dents in rigid or semi-rigid components will make it very difficult for the scope and its attachments to be assembled properly. If the scope itself has become bent or bowed, the physician could also have difficulty assembling it during a procedure. “Any malfunction of an accessory or instrument during a procedure could result in injury to the patient and further damage to the instrument” (http://www.urologicservices.com/documentation/karl-storz-general-reprocessing-instructions.pdf).

It is very important for identification purposes to recognize the differences between specialty items when they are still fully assembled. Making this identification during inspection will prevent the wrong set from making its way up to the OR, which will delay a case if another set is not available.
Figure 9-44 — Disassembled rigid resectoscope

Figure 9-45 — Rigid resectoscope assembled from components shown in Figure 9-44

Figure 9-46 — Dent in sheath will prevent proper assembly
**NOTE: The Quiz for this topic is given AFTER you complete Module 23.

Please click on the link below to go to Module 23.

https://www.spdceus.com/modules/sixth/tech/module23_pay.htm