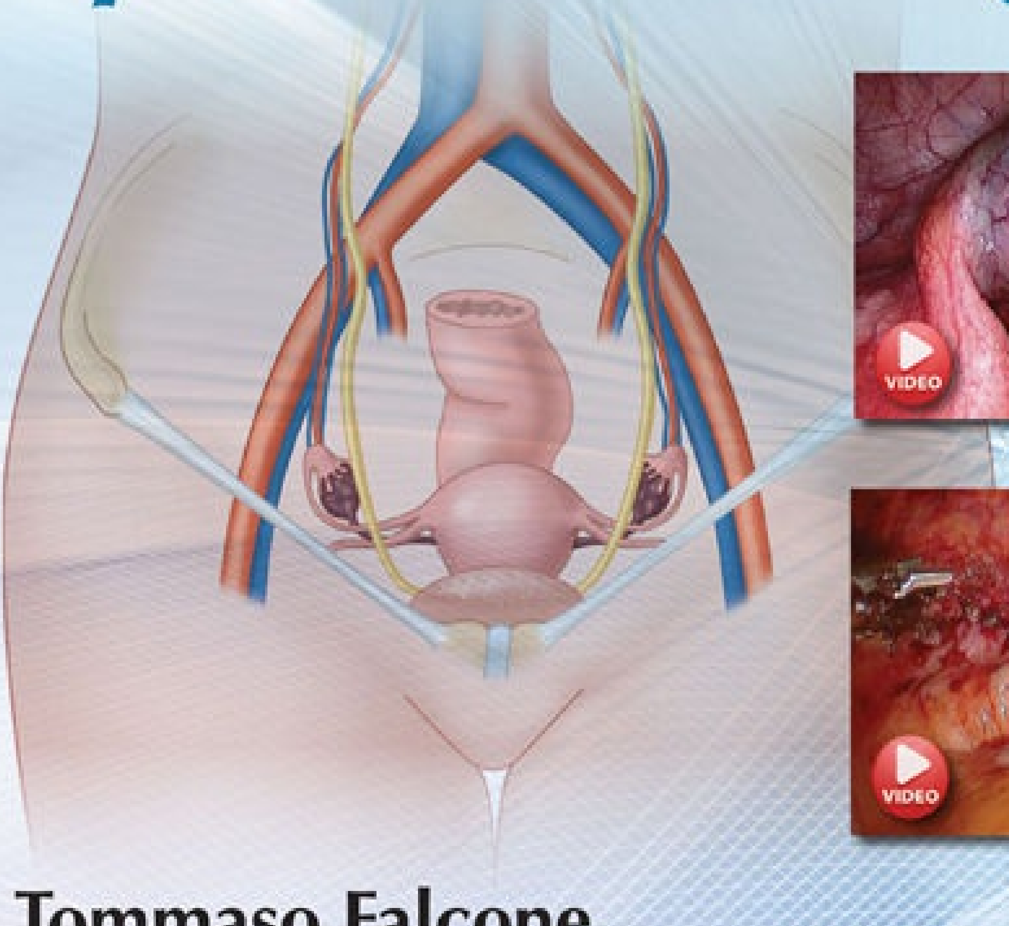
OPERATIVE TECHNIQUES IN GYNECOLOGIC SURGERY

Gynecology



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Operative Techniques in Gynecologic Surgery

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Foreword

Operative Techniques in Gynecologic Surgery is presented in four volumes—*Gynecology, Reproductive Endocrinology and Infertility, Urogynecology and Pelvic Reconstructive Surgery*, and *Gynecologic Oncology*. Their purpose is to provide clear and concise illustrations of essential operations representing the fundamental procedures for each of these subspecialties. This series is distinct from other textbooks in gynecology because of their focus as an illustrated practical guide to the surgical processes using easily accessible photographs and video clips.

In *Gynecology*, this first in the series, we depict the most common operations of our clinical specialty. The second does the same for *Reproductive Endocrinology and Infertility*, the third for *Urogynecology and Pelvic Reconstructive Surgery*, and the fourth for *Gynecologic Oncology*. We assembled a group of outstanding authors and contributors to produce these volumes, under the guidance of highly regarded expert senior book editors.

Gynecology—Tommaso Falcone, MD, is the Head of Gynecology at the Cleveland Clinic and is well known for his expertise in the operative management of benign gynecologic conditions. He and his co-authors, M. Jean Uy-Kroh, MD, and Linda D. Bradley, MD, have carefully assembled a very useful series of photographs and videos that highlight the fundamentals of the surgical operations in our field.

Reproductive Endocrinology and Infertility—Steven Nakajima, MD, is a Professor of Obstetrics and Gynecology at the Fertility and Reproductive Medicine Center, Stanford University School of Medicine, and his focus is on the procedural and operative aspects of. Along with the contributions from his colleagues, Travis W. McCoy, MD, and Miriam S. Krause, MD, this book will serve as a clear summary of the necessary procedures in this specialty.

Urogynecology and Reconstructive Pelvic Surgery—Christopher Tarney, MD, is an Associate Professor at the David Geffen School of Medicine at UCLA, where he is the Chief of Urogynecology and Reconstructive Pelvic Surgery. He and his colleague, Lisa Rugo-Gupta, MD, Clinical Assistant Professor, Stanford University School of Medicine, have contributed substantially to our understanding of the important discipline of Female Pelvic Medicine and Reconstructive Surgery.

Gynecologic Oncology—Kenneth Hatch, MD, is a well-known gynecologic oncologist who is a Professor at the University of Arizona School of Medicine. He is considered one of the primary experts in the surgical management of gynecologic malignancies. Dr. Hatch and his contributors will provide a precise visual explanation of the essential operative treatments in this subspecialty.

We intend this series to enhance the educational activities for our colleagues in the practice of Gynecology and dedicate this series to our patients in the hope that it will facilitate optimal care and improved outcomes for our patients.

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Preface

We are confident this textbook will be widely read, intensely discussed, and most of all utilized as a dynamic compendium to improve the surgical care and outcomes of patients. This textbook includes a variety of visual formats with numerous high-quality images. It succinctly describes optimal technique and is beautifully illustrated. In addition, outstanding videos capture procedures step by step. You will feel that you are in the operating theatre with an experienced surgeon who meticulously instructs you through the case.

The authors were chosen for their surgical expertise and are thought leaders in gynecology. The body of this work epitomizes the surgical dictum, "Do as much as necessary and as little as possible." Our goal is to provide you the tools needed to teach modern gynecology, perform minimally invasive surgery, and to recognize and treat complications should they occur.

We are indebted to our families who understood the time commitment required to complete this project. We are indebted to our colleagues who submitted chapters and provided unabashed video critiques. And most importantly, we are indebted to our patients who continue to teach and inspire us. We appreciate the trust and confidence of the women we serve.

Tommaso Falcone, MD, FRCS(C), FACOG
M. Jean Uy-Kroh, MD, FACOG
Linda D. Bradley, MD, FACOG

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Basic Surgical Setup

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Bianca Falcone, M. Jean Uy-Kroh

1 Basic Setup and Equipment for Laparoscopic Surgery

Cynthia Arvizo, M. Jean Uy-Kroh

OPERATING ROOM SETUP

The operating room (OR) should be set up to allow mobility of members of the surgical team throughout the room, quick access to instruments, patient safety, and comfortable surgeon positioning. The OR table should be electric to allow for easy positioning of the patient during the case. Overhead lighting should be placed over the surgical field. The light source, monitor, and insufflator may be located on one mobile boom or suspended from the ceiling. A monitor should be placed directly in front of each surgeon to facilitate ergonomic operating. If only one monitor is available, the monitor should be placed between the patient's legs. Two separate sterile surgical fields are set for abdominal and vaginal instruments. Ideally, the scrub nurse is positioned between the patient's legs, or as close to the surgical field as feasible.

THE IMAGE

The imaging chain consists of seven devices: light source, light cable, laparoscope, camera head, camera control unit, digital cable, and the monitor. Malfunction of any of these components will lead to suboptimal image quality and disruption of the surgical case.

Troubleshooting during a surgical case is inevitable but sound knowledge of the imaging chain saves time.

Light Source and Light Cable

Good image quality is dependent on good lighting. The most widely available light sources use xenon, metal halide, or LED bulbs. LED bulbs are touted as more eco-friendly because they emit less heat and last longer than xenon bulbs. Light is transmitted from the light source through a light-guide cable. Two types of cables are available—fiber optic and liquid cables. Most ORs are equipped with fiber optic cables.

Laparoscope

Several laparoscope designs are available on the market. The two most common types of laparoscopes are a hollow rod with a series of lens connected to a video camera (rod–lens system) or digital systems with a charge-coupled device (CCD) at the end of the laparoscope. The digital laparoscope unites the video and light cable. A variety of scope diameters are available. Scope diameters as small as 1 mm exist, but most operative gynecologic surgery is performed with 5- or 10-mm zero-degree laparoscopes. Flexible and angled laparoscopes can significantly aid visualization, particularly when dealing with a bulky and enlarged uterus.

Camera, Camera Control Unit, and Monitor

The laparoscope attaches to the camera head, which is connected to the camera control unit (CCU) via the digital cable. Cameras are provided as one-chip or three-chip devices. Three-chip cameras are most commonly used today as they provide higher resolution than one-chip devices. An image passes through the lens on the camera head. A prism within the camera head splits light into three primary colors (red, blue, and green) each with a corresponding CCD. The CCD converts the image to an electric signal that is transmitted to the CCU. The CCU can then send the image as either analog or digital video outputs or signals for viewing and recording.

Insufflator

Surgery cannot be safely performed without adequate insufflation. An insufflator delivers carbon dioxide into the peritoneal cavity and maintains a set pressure and an inflow rate. Intracavitary pressure of 12 to 15 mm Hg produces sufficient pneumoperitoneum for most laparoscopic cases. Various insufflating systems offer additional features such as warmed, humidified carbon dioxide, concomitant smoke evacuation, and filtration. Leaky gaskets, cracked, poorly connected, or kinked tubing, and empty gas tanks are common causes of poor or absent insufflation.

INSTRUMENTS AND EQUIPMENT

Proper, well-functioning instruments allow for a smooth surgical case. In gynecologic laparoscopy, two sets of instruments are routinely utilized—vaginal and laparoscopic.

Vaginal Instruments

In general, the vaginal instruments aid in placing the uterine manipulator. The most basic set should include an open-sided speculum or Auvard weighted speculum, Sims vaginal retractor, single-toothed tenaculum, ring forceps, uterine sound, Hulka tenaculum, and cervical dilators.

There are several uterine manipulators available. The preferred manipulator is a cost-effective device that adequately manipulates and serves the needs for the particular surgery. The most basic manipulator is a reusable Hulka tenaculum. Other manipulators may provide additional functions such as a chromopertubation port, custom-sized colpotomy cup, built-in vaginal occluder, ante/retroflexion capabilities, and an angled curvature and sliding mechanisms to facilitate cervical insertion. Certain devices may be preferred for their durability with heavy specimens or they may work as accessories to surgical positioning units.

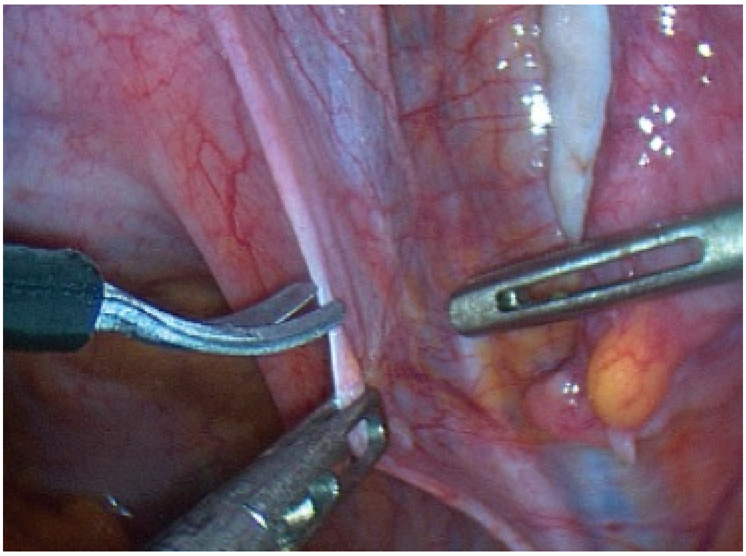

Figure 1.1. Scissors **(top left)**. Atraumatic bowel grasper **(top right)**. Allis forceps **(bottom)**.

Laparoscopic Instrument

Trocars

Trocars range between 2 and 15 mm and are used to insert laparoscopes and instruments. They vary in material, reusability, tip type, valves, and specialized characteristics such as peritoneal balloons and insufflation mechanisms.

Graspers and Scissors

Most laparoscopic instruments are available in 3-, 5-, and 10-mm diameters. Additionally, bariatric instruments are available to accommodate the unique needs of high BMI patients. Each grasper serves a different, specialized purpose. For example, atraumatic graspers are used to gently manipulate tissue. The Maryland dissector is useful for fine tissue handling and coagulation. The Allis forceps firmly holds tissue and is ideal for creating tissue traction. A laparoscopic tenaculum manipulates the uterus and proves useful for traction during myomectomies. Atraumatic bowel grasper's smooth texture allows for safe retraction of the bowel. A variety of scissors with coagulative capabilities are employed for cutting tissue with and without the use of electrosurgery (Fig. 1.1).

Other Basic Instruments

Surgeon preference dictates the type of needle holders and knot pushers that are used for extracorporeal knot tying.

During gynecologic cases, safe specimen removal through small laparoscopic incisions is expedited with different instruments. Spoon forceps collect small specimens, such as clot or fragments of tissue. Specimen retrieval bags are either disposable or reusable plastic bags that minimize content contamination during the removal process. Smaller specimens may be delivered through trocars, but large specimens are brought up to the abdominal incision and the bag is opened to expose a part of the specimen.

Fascial closure systems introduce a needle with suture alongside the defect under direct visualization to close fascial defects greater than 10 mm. The needle is removed and reintroduced on the contralateral side. The suture is grasped, externalized, and tied.

Suction and Irrigation System

Suction and irrigation maintain a clear view and surgical field. The most rudimentary setup is a syringe attached to a hollow probe. When a surgery demands more rigorous assistance, a handheld, battery-powered system is connected to a standard OR suction. In addition, irrigation tubing connected to liter bags of Lactated Ringer's solution or saline is employed.

ENERGY SOURCES

The widespread use of operative energy sources necessitates a basic understanding of these energies and their devices. Radiofrequency (RF) electric, ultrasonic, laser, and plasma energy all generate heat, but they vary dramatically in their mechanics. The most commonly utilized energies, RF electrical energy and ultrasonic energy, are briefly described.

Radiofrequency Electrical Energy

RF electrical surgery delivers heat created by alternating current conducted through two electrodes. Monopolar instrumentation relies on a small "active" electrode and a larger "dispersive" or return electrode (Fig. 1.2). By definition, the patient is part of the electrical circuit. When a surgeon applies energy, electrons move through the tissue and generate heat. In addition to the type of current applied, surgical dwell time on tissue and the surface area of the active electrode collectively determine the thermal effect on both the target and surrounding tissues.

Three types of waveforms are routinely employed in the operating room are cut, coagulate, and blend. Cut current is a high-frequency, low-voltage continuous waveform that results in rapid tissue heating with little to no hemostasis. The electrode's proximity to the tissue leads to either vaporization (indirect contact tissue with resulting air gap) or dessication (direct contact with tissue). Coagulation current greatly interrupts the continuous waveform used in cutting mode and, as a result, produces a low-frequency, high-voltage waveform. Coagulation current's high voltage increases the potential for heat to deeply penetrate the tissue, thus causing "thermal spread." Blend current is an intermediate frequency, and is truly a "blended" form of cut current.

Unlike monopolar instruments, bipolar instruments rely on intervening tissue between the two electrodes to complete the electrical circuit. An example of this is the traditional bipolar Kleppinger forceps that is used to achieve hemostasis or tissue desiccation (Fig. 1.3). The thermal spread caused by the traditional bipolar instruments can be undesirable. Over time, "advanced bipolar" devices have emerged that combine various energy forms and rely on newer adaptive electrosurgical units (ESUs) that perceive and calculate tissue resistance encountered by the electrode tip. The ESU processes this information to modulate the power output to match the clinical scenario.

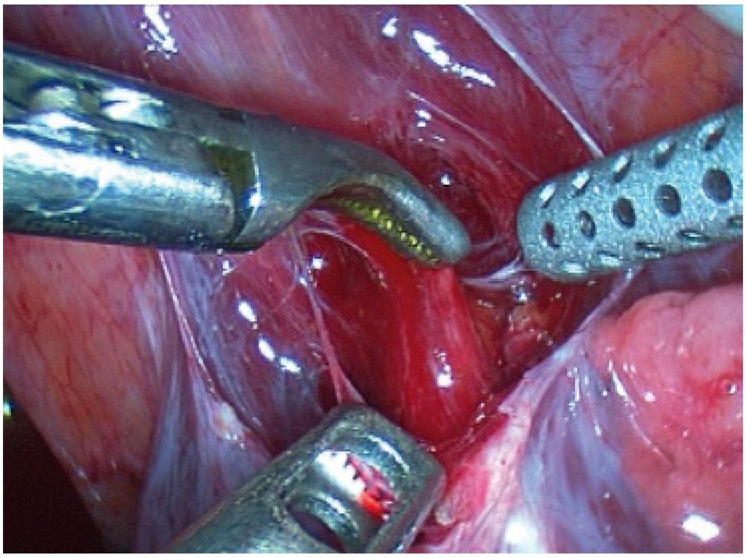

Figure 1.2. Maryland dissector (**top left**) with a fine grasping tip for tissue handling and monopolar radiofrequency energy application. Suction irrigator (**top right**). Allis forceps (**bottom**).

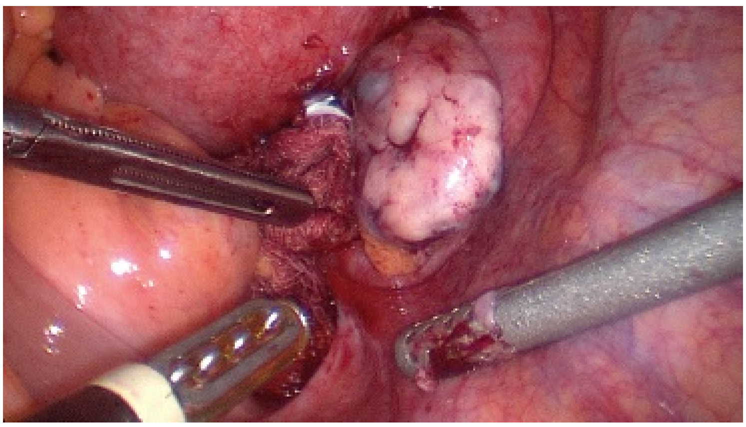

Figure 1.3. Kleppinger bipolar radiofrequency device (**bottom left**) with battery-powered suction irrigator (**bottom right**) and atraumatic grasper (**top left**).

Other newer technologies fuse energies. Some examples include the LigaSure Advance (Valleylab) which integrates advanced bipolar and monopolar energies (Fig. 1.4). The Thunderbeat device (Olympus) combines ultrasonic and advanced bipolar technologies. In addition to devices, there has been an introduction in novel energy delivery systems. An example of this is the Valleylab waveform that modulates coagulation current instead of a continuous cut current. In theory the effect is reduced tissue drag, when compared to the standard coagulation current, and greater hemostasis than compared to the cut current.

Ultrasonic Energy

Ultrasonic energy exerts mechanical energy to create frictional heating. The active blade of the ultrasonic shears vibrates about 55,500 times per second causing low-temperature denaturation, while the nonactive blade holds tissue in place. Similar to RF energy, the cycling of the active blade determines the energy mode employed. Rapid cycling results in cutting with less hemostatic properties, whereas slow cycling is less precise but creates more energy dispersion.

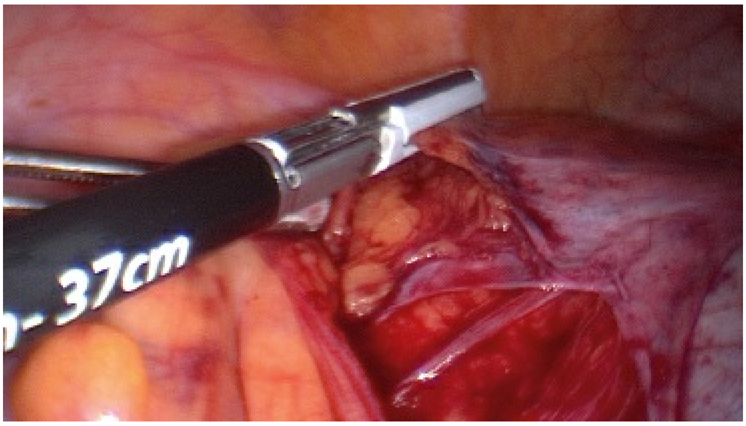

Figure 1.4. Ligasure (Valleylab) advanced bipolar device.

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Basic Equipment and Setup for Robot-Assisted Laparoscopic Surgery Using the Intuitive Da Vinci Si Robot

2

Tommaso Falcone, Henry F. Kraft

GENERAL PRINCIPLES

There are several steps to efficient use of the robot:

1. Correct choice of equipment during surgery.
2. Correct placement of robotic ports for effective pelvic surgery.
3. Correct docking so as to maximize the full range of motion of the robotic arms.

This chapter will cover the use of a multi-port robot-assisted laparoscopic procedure.

INSTRUMENTS AND EQUIPMENT

Correct Choice of Equipment During Surgery

- It is critical to choose the correct instruments required for a procedure. Surgery must be cost-effective, so it is inappropriate to simply keep changing instruments during the procedure until you find the one that works. The surgical approach should be carefully planned and appropriate instruments chosen to reduce exchange of instruments and be cost-effective. Each surgical procedure has some basic instruments required—a grasper appropriate for the case, an energy form for hemostasis, and a cutting instrument such as scissors.
- Figure 2.1 shows some basic instruments.

Correct Port Placement

- After the patient has been properly positioned in dorsal lithotomy, prepped, and draped, and a proper time-out has been done, incision is made, and the ports are placed.
- There are different possibilities for placement of robotic ports based on pathology and type of procedure. The camera port can be placed at the umbilicus for most procedures. The assistant/accessory ports are placed in the left or right upper quadrant.
- However, if the uterus is large, a supra umbilical port is necessary.

- The camera port should be placed 2 to 4 cm higher than the umbilicus so as to maintain a 10 cm working distance between the tip of the endoscope and the fundus of the uterus.
- Likewise, the 8-mm robotic instrument ports should also be moved higher in tandem with the movement of the camera port.
- It is also noteworthy that all precautions should be taken to keep the tip of the endoscope from touching any of the surrounding tissue. It is hot and can cause thermal injury.

Scenario 1

- It is a standard four-arm configuration, where the camera port is placed at the umbilicus and the 8-mm robotic ports are placed each at least 8 to 10 cm lateral to the camera port.
- See **Figure 2.2**.

Scenario 2

- It is a three-arm configuration, where the camera port is placed at the umbilicus and only two robotic instrument arms are used. Each robotic instrument arm should be placed 8 to 10 cm lateral to the camera port.
- See **Figure 2.3A**.

Scenario 3

- Another approach is a four-arm configuration where robotic port no. 2 is placed higher (closer to the costal margin). This is particularly advantageous with smaller patients.
- See **Figure 2.3B**.

Scenario 4

- There are exceptions to introducing the assistant/accessory port in the upper abdomen. For tubal reanastomosis, a three-arm configuration is used as in **Figure 2.3A**. However, in this scenario, a 12-mm assistant/accessory port is placed in the lower quadrant so that small needles can be introduced and extracted under direct vision.

Docking the Robot

- After the ports are placed, and the patient is positioned in the proper amount of Trendelenburg, lower the operating room table to the lowest position possible.
- Place the patient's legs as close together as the yellowfin stirrups will allow —this will enable maximum access and visualization as the robotic patient cart approaches the OR table.
- Align the patient cart base pointing toward the patient, with a starting

point 2 to 3 ft beyond the yellowfin stirrups, and oriented so as to be able to come straight toward the patient's umbilicus on a 45-degree angle to the patient's longitudinal axis.

- See **Figure 2.4**.
- If maneuvering the patient cart is difficult due to the confines of a small OR, it can be helpful to preemptively angle the OR table 15 degrees to one side or the other in order to facilitate advancing the patient cart on a 45-degree angle to the patient's umbilicus and longitudinal axis.

Figure 2.1. **A:** Robotic Vessel Sealer—energy form for hemostasis and cautery. **B:** ProGrasp Forceps—grasping forceps for manipulation of tissue. **C:** ProGrasp Forceps versus Cadiere Forceps—side-by-side comparison. Grasping forceps for manipulation of tissue. **D:** Maryland Bipolar Forceps—bipolar energy form for hemostasis. Grasping forceps for dissection and manipulation of tissue. **E:** Monopolar Scissors—monopolar energy form. Cutting and cauterization of tissue. **F:** Permanent Cautery Hook—monopolar energy form. Divides and cauterizes tissue. **G:** Mega Suturecut Needle Driver—dual function instrument. Both drives needle through tissue and cuts suture. **H:**

Large Needle Driver—drives needle through tissue. Medium size jaws are more appropriate for smaller needles. **I:** Black Diamond Needle Driver—drives needle through tissue. Fine tip jaws needed for very small needles. (Reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2015 all rights reserved.)

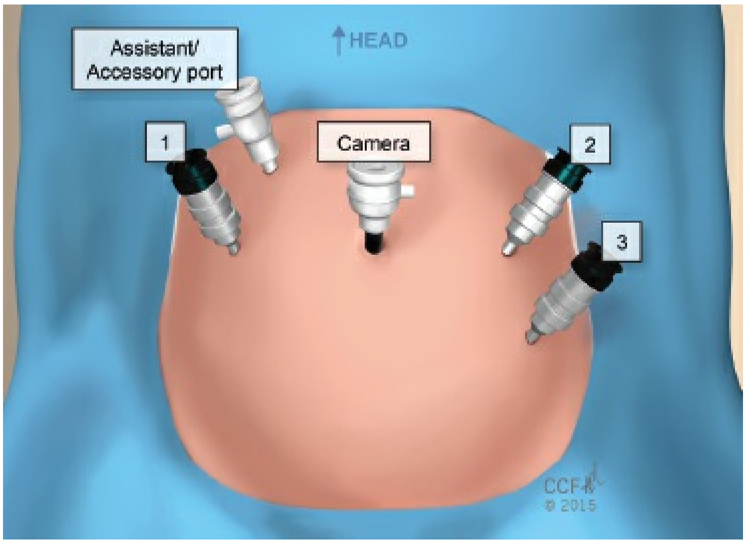


Figure 2.2. Port placement for standard four-arm side docking of the Intuitive Da Vinci Si robot. Numbers 1, 2, and 3 are 8-mm robotic instrument arm ports. (Reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2015 all rights reserved.)

- Place the robotic endoscope arm, so the sterile adapter, clutch buttons, and patient cart center column are in alignment, as well as centered between the legs of the patient cart base.
- The camera arm setup joint (which is the articulating joint on the robotic endoscope arm closest to the patient cart center column) should be articulated to the same side as robotic instrument arm no. 1. There is no consideration necessary for the "sweet spot" (blue band) found on the camera arm setup joint when side docking.
- See Figure 2.5.
- Extend robotic instrument arms no. 1, no. 2, and no. 3, so they are evenly spaced at approximately a 45-degree angle on either side of the robotic endoscope arm.
- See Figure 2.6.

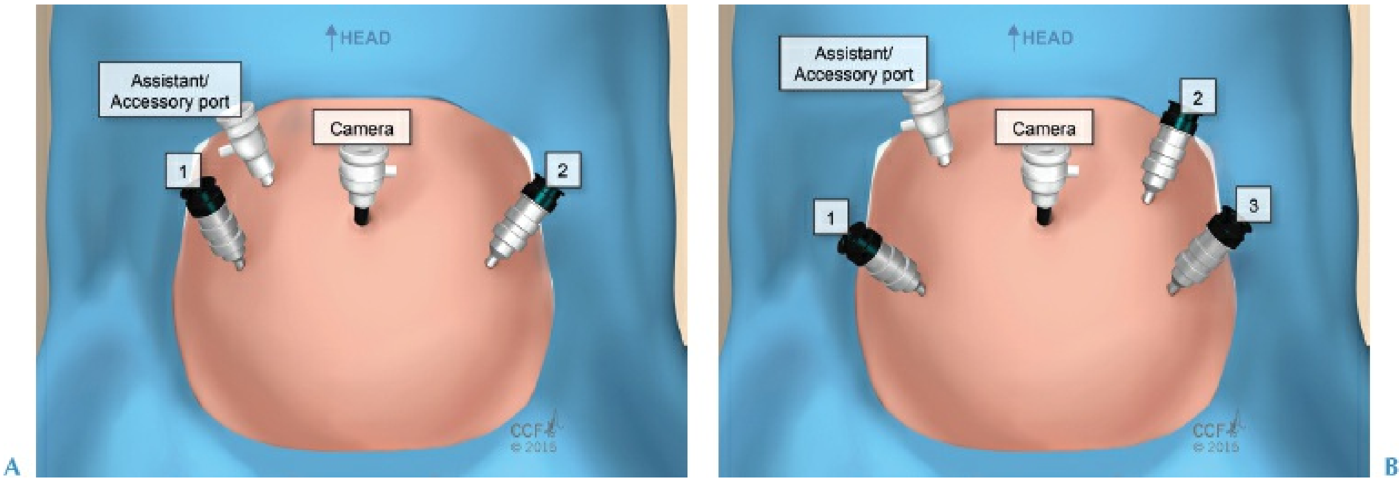


Figure 2.3. **A** and **B:** Alternate port placement. **A:** Three-arm port placement. Numbers 1 and 2 are 8-mm robotic instrument arm ports. **B:** Four-arm port placement for smaller patients. Numbers 1, 2, and 3 are 8-mm robotic instrument arm ports. (Reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2015 all rights reserved.)

- Before advancing the patient cart toward the OR table, extend the robotic endoscope arm slightly forward of the robotic instrument arms, with a 45-degree forward tilt of the sterile adapter, as this will be a helpful indicator when approach to the OR table should be stopped and the brakes on the patient cart set.

Figure 2.4. Demonstrates the 45-degree angle of approach for the patient cart toward the OR table. Surgeon directs the angle of approach. (Reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2015 all rights reserved.)

- See **Figure 2.7A**.
- The OR table base (closest to the patient's foot) serves as a helpful landmark, approximately coinciding with the 45-degree angle of approach to the patient's umbilicus and longitudinal axis necessary for docking.
- See **Figure 2.7B**.

- Slight adjustments may be necessary if using the table base as a landmark due to variance in both the size and shape of the base of OR tables (company and model dependent).
- Patient body habitus plays a role in determining how close along the 45-degree angle the patient cart should be from the OR table.

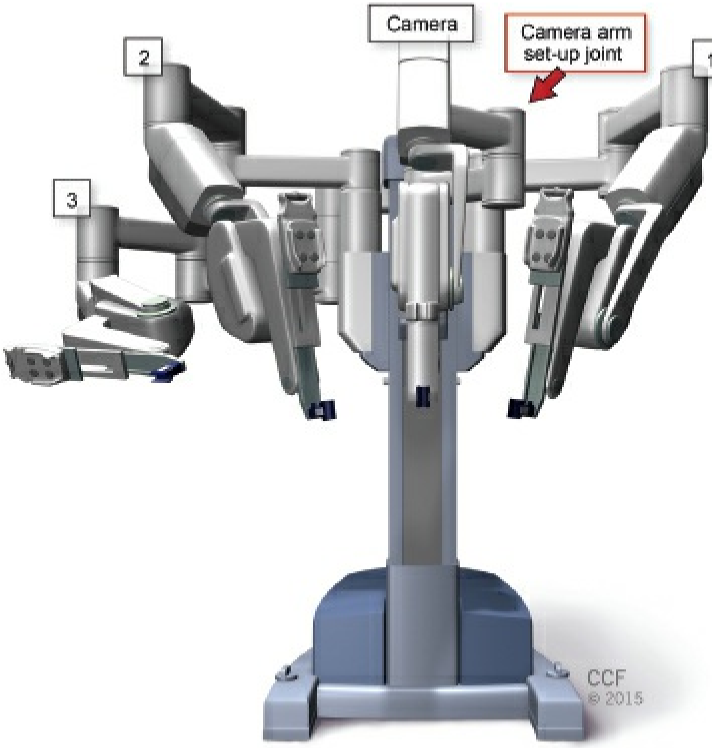


Figure 2.5. Starting position for robotic arms on patient cart. Note camera arm setup joint is angled opposite arm no. 3. (Reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2015 all rights reserved.)

Attaching the Robot Arms to the Trocars

- The robotic endoscope arm should be docked first, in order to confirm that the 45-degree angle and the distance of the patient cart from the OR table are correct.
- Note the alignment of the camera port in the umbilicus, the anterior superior iliac spine (ASIS), the robotic endoscope arm, and the patient cart center column.
- See Figure 2.8.
- If any of those are not correct, this is the time to make the adjustments.

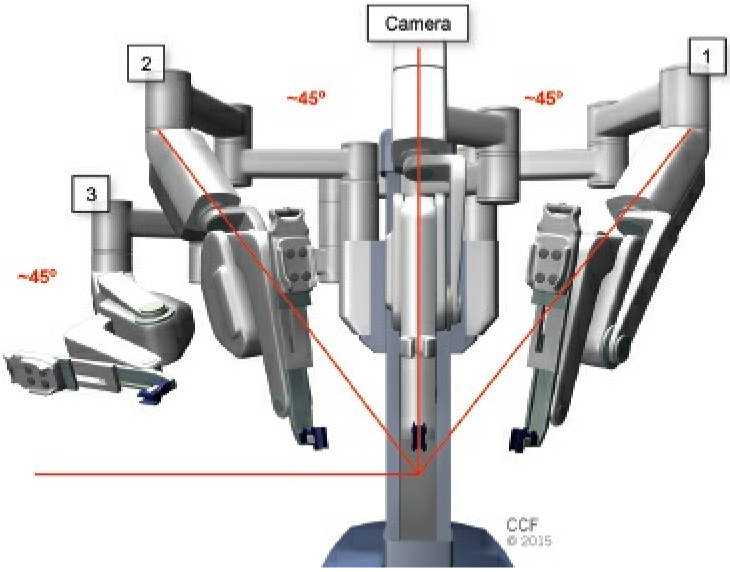
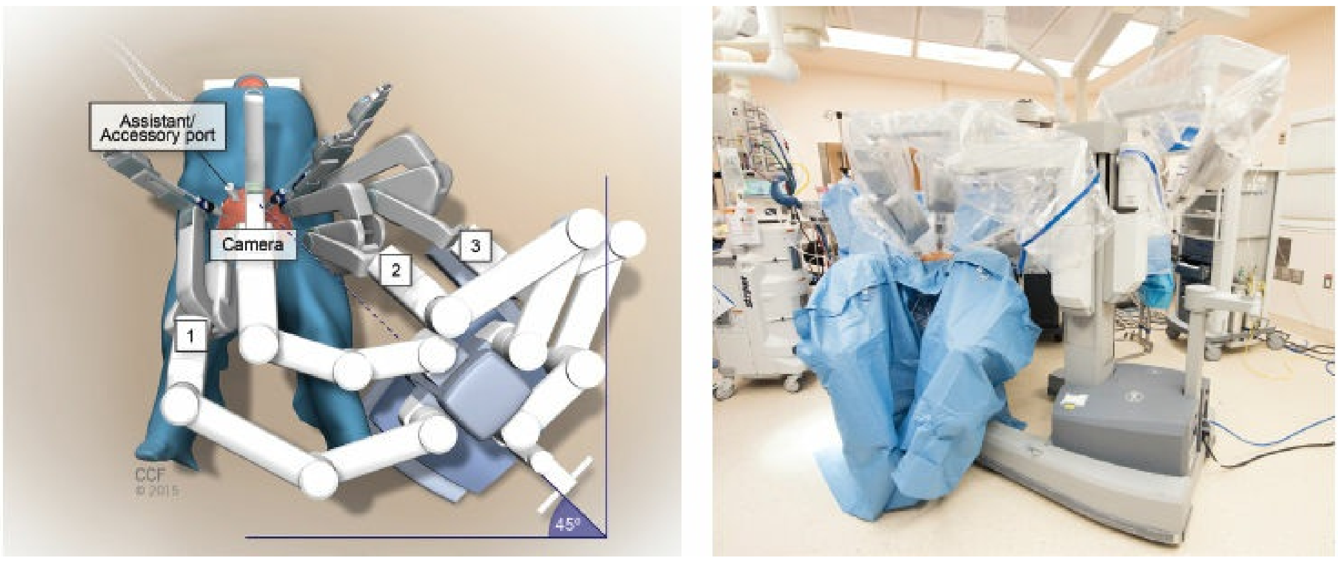


Figure 2.6. Forty-five–degree angle between each of the robotic arms. Note alignment of the endoscope arm sterile adapter and patient cart center column. (Reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2015 all rights reserved.)

- When docking the robotic endoscope arm, make sure the patient's skin does not become pinched between the cannula and the quick click cannula mount.
- After the camera port (12-mm cannula) is docked to the robotic endoscope arm, ensure that the luer-lock on the side of the 12-mm cannula is rotated to the patient's left or right so as to avoid blunt force trauma to the abdomen.
- For patients that have a low BMI, a way to keep the robotic instrument arms from colliding with the robotic endoscope arm is to use an extra-long 12-mm endoscope cannula in the umbilicus.



A B

Figure 2.7. **A:** Patient cart base at a 45-degree angle to OR base. **B:** Robotic patient cart base at approximately 45-degree angle to the base of OR table. Yellowfin stirrups

as close together as possible. Patient in desired amount of Trendelenburg. OR table in its lowest position toward the floor. (Reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2015 all rights reserved.)

- Insert it so that only the distal 2 cm of the cannula is visible in the abdominal cavity. This will raise the attachment point of the robotic endoscope arm to the 12-mm endoscope cannula, allowing for a greater range of motion for the robotic instrument arms intraoperatively.

Figure 2.8. Note alignment of the camera port in the umbilicus, the ASIS (anterior superior iliac spine), the robotic endoscope arm, and the patient cart center column. (Reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2015 all rights reserved.)

- Next, dock the robotic arms to their respective 8-mm robotic cannulas. This can be done at the same time if there are two people scrubbed at the time of docking.
- In our experience, during a tubal reanastomosis, using only robotic arms no. 1 and no. 3 allows more free space on the patient surface.
- Noteworthy, the difficulty in docking the 8-mm robotic ports can be greatly reduced by ensuring the drape is properly fitted on the quick click cannula mount and holding it there with your thumb.
- While holding the 8-mm robotic port perpendicular to the abdomen with one hand, press the port clutch button and bring the robotic arm in at the same perpendicular angle with the other hand. This will maximize visualization throughout the process.
- When the quick click cannula mount is properly interfaced with the 8-mm cannula, squeeze the front of the quick click cannula mount together with one hand, before squeezing the wings of the cannula mount together with your other hand.
- You will find docking the robotic arms to the robotic cannulas quick and

easy using this technique.

- Lastly, "Burp" each of the robotic arms by pressing the robotic arm port clutch button. This is an important last step where the robotic center for each port is established.
- See Figure 2.9.

Introducing the Endoscope

- Connect the robotic camera to the robotic endoscope.
- Ensure the (sterile) draped camera cord does not fall as you bring the robotic camera and cord to the sterile field.
- Insert the distal end of the robotic endoscope carefully into the opening of the endoscope cannula, lifting the camera body toward the sterile adapter ring as you do.
- Be sure to orient the buttons on the endoscope camera housing so that they are facing the robotic endoscope sterile adapter.
- Place two fingers under the sterile adapter ring and gently lift as you insert the endoscope. This will aid in the ease of locking the endoscope into place.
- The last step in preparing the robotic arm endoscope for use is to secure the yellow rubber endoscope camera cord cable block in the robotic endoscope arm clip (found on the right side of the robotic endoscope arm, to the side of the sterile adapter).

Figure 2.9. Robotic arms docked and robotic center established for the cannulas. (Reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2015 all rights reserved.)

- Press the robotic endoscope arm clutch button and advance the endoscope into the abdomen.
- While activating the endoscope clutch button, rotate the endoscope so as to visualize the distal end of the robotic instrument cannula before advancing