Special Interview: Potential of Endoscopic Surgery

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Sumio Matsumoto

1973: Graduated from Keio University School of Medicine
1973: Trainee Surgeon, Keio University School of Medicine
1980: Surgeon, National Hospital Organization Kanagawa Hospital
1982: Assistant Professor in Surgery, Nagoya Health University School of Medicine
1984: Assistant Professor in Surgery, Fujita Health University College School of Medicine
1990: Associate Professor of Surgery, Fujita Health University School of Medicine
1993: Professor of Surgery, Fujita Health University School of Medicine
2000: Director, Banbuntane Hotokukai Hospital, No. 2 Teaching Hospital, Fujita Health University
2005: Director, National Hospital Organization Tokyo Medical Center
2014: Honorary Director, National Hospital Organization Tokyo Medical Center

Notable involvement in academic associations, etc.
Member of the New Strategy Promotion Special Investigating Committee, Strategic Headquarters for the Promotion of an Advanced Information and Telecommunications Network Society; Auditor, Japan Society for Endoscopic Surgery; former Executive Director, Japan Hospital Association; chairman of the ethics committee, member of the social insurance medical care fee committee, and member of Gaihoren at the Japan Hospital Association; chairman of the 25th Conference of the Japan Society for Endoscopic Surgery; chairman of the 62nd Conference of National Hospitals; Administrator, 28th Conference of the Japanese Research Society of Surgical Cancer Immunology; Advisor, Japan Laparoscopic Hernia Surgery Society, and other positions

Endoscopic surgery has made dramatic advances in recent years, with operations such as gallbladder removal having become standard procedures. We spoke to Sumio Matsumoto, Honorary Director of the Tokyo Medical Center, about the potential for further advances in this field.

Q: What has endoscopic surgery brought to the field of surgical treatments?

A: The biggest difference from open surgery is that endoscopic surgery is a minimally invasive therapy. By enabling patients to return quickly to their daily lives, this has reduced losses on both an economic and a social level. When I first became a surgeon about 40 years ago, the attitude of open surgery was "the greater the wound, the greater the surgeon," with patients unable to get up for a week due to pain from the wound. In contrast, in the case of a simple benign procedure, patients who have undergone modern endoscopic surgery can be up and about ready to return home the following day.

The widespread adoption of endoscopic surgery began after it built up a reputation for success in surgery for cholelithiasis (gallstone disease), a non-malignant condition. I had my eyes opened to the technique at a video session on gallbladder removal during an international conference on gastrointestinal surgery in Toronto in 1989, and only a year later in 1990 I performed my first local excision of an early gastric carcinoma.

In 1991, I performed the first inguinal hernia operation in Japan. In those days, many surgeons were unfamiliar with laparoscopic surgery, with many preferring to use the mesh plug insertion procedure which has a simpler frontal approach, and therefore interest temporarily died down in the laparoscopic repair of inguinal hernias, a surgical technique that is difficult to learn. Nevertheless, the simpler technique doesn't sufficiently reinforce the area where the hernia occurred, resulting in relapses and other negative outcomes. This led to a recognition of the benefits of using laparoscopic surgery, which enables the surgeon to directly observe what is happening as they work and thereby to properly reinforce the site of the hernia and prevent a relapse, and I have been aware of a rising number of surgeons wanting to learn the technique since around 2012. A survey by the Japan Society for Endoscopic Surgery showed a rise in the relapse rate over the past few years. I suspect this may be the result of procedures not being performed appropriately because of the large number of surgeons adopting the technique for the first time. I would like to take advantage of mechanisms such as skill qualification examinations to promulgate appropriate practices.

In the case of operations on malignant tissue, laparoscopic excision of colon cancers was first reported in 1993, with operations such as gastrectomies and esophagectomies (respectively, removal of part of the stomach or esophagus) now in the process of becoming standard procedures in recognition of the reduced stress they impose on the patient. In fact, laparoscopic surgery has become widely used for cancer surgery at high-volume centers (clinics that operate on a large number of cases) that perform a variety of difficult surgical procedures.

Q: How will minimally invasive therapy become more widely adopted in the future?

A: When you look at the current situation, where laparoscopic surgery is desirable for both surgeons and patients, I believe it will spread into new fields, such as cancer of the larynx and pharynx in ear, nose, and throat (ENT); cancer of the uterus in gynecology; and cardiac bypass surgery.
However, endoscopic surgery is a difficult technique to learn and having it more widely adopted as a safer surgical procedure requires robust mechanisms to be put in place through the skills certification program that commenced in 2005 by the Japan Society for Endoscopic Surgery. The skills certification program allocates 60 points to generic skills such as the use of forceps and electrosurgical knives during general endoscopic surgery, and 40 points to the various organs, with the two independent examiners needing to award a total of 70 points or more to achieve a pass. However, certification does more than just qualify the surgeon to use the technique, rather it is intended to assess whether they have reached the level needed to be a supervising surgeon. The pass rate of 30% to 40% means that certification is very difficult to obtain by the standards of such industry qualifications.

Q: Will use of endoscopic surgery also spread to emerging nations?

A: Surgeons from emerging nations who have acquired skills through study in nations with well-developed medical practices are using endoscopic surgery in their home countries. There is a training facility for endoscopic surgery in Taiwan that is headed by a French surgeon, and I have visited there to teach about inguinal hernia repair operations. I noted that they even had people coming to train there from Australia.
I understand that Olympus has opened training facilities in Thailand and China at Beijing, Shanghai, and Guangzhou. I have been aware of young surgeons from places such as South America and Central Asia coming to train in Japan over the last 30 years, and with endoscopic surgery likely to become routine in these countries as they become more developed, I believe that training institutions like these that include endoscopic surgery as well as gastrointestinal endoscopy will be needed all over the world in the future.

Q: How do you see the technology of surgical endoscopy developing in the future?

A: Olympus 3D endoscope looks like an extremely promising instrument. For example, delicate tasks such as suturing are difficult for beginners to perform using a 2D image because it is so hard to get good depth perception, and it has been demonstrated that 3D images that provide a sense of depth make a significant difference by shortening the time taken for such tasks.
Robotic assisted surgery, meanwhile, not only reduces the physical workload of the surgeon, it is also said to shorten the time taken for surgical training compared to laparoscopic surgery. Prostatectomies using the American-made Da Vinci system received insurance cover approval in 2012, and at the Tokyo Medical Center we have already performed robotically assisted gastrectomies several times. Since this uses two cockpits, with two surgeons working alternately to perform the operation, it enables a new relationship unlike the surgeon and assistant relationship used for open surgery.
In the future, I would like to see Olympus developing the sort of products that only you could produce. In terms of what surgeons like myself are looking for, numerous research institutions are working on developments such as robot arms that can perform automatic suturing or ligation, or forceps that provide tactile feedback, and I look forward to these being commercialized.
I am also a member of the Cabinet Office's IT Promotion Strategy Committee, and speaking in that capacity there is a need for the development of instruments and services that

incorporate advances in IT. For example, capsule endoscopy is used to perform examinations by having a receiver collect data from a capsule inside the patient's body. Shouldn't it also be possible to have a service that sends this data via a network to a facility with diagnostic capabilities, and then receives a prompt result? Because this only requires the patient to swallow the capsule, it would enable examinations to be carried out even in places that lack medical infrastructure, such as clinics that do not have an endoscopy specialist.
Furthermore, work is also progressing on systems that get patients to fill out a questionnaire on a PC or tablet computer while they wait at an outpatient clinic, thereby making their electronic medical records immediately available. This enables doctors to quickly identify the suspected ailment when they carry out a diagnosis, and deal promptly with things like getting tests done. Such systems are close to being realized and should be ready by the time of the Tokyo Olympics.
Using IT in this way to improve services is also vital when you consider the trend toward an aging population and lower birth rate, and I believe Olympus needs to produce systems that are compatible with such an environment.

Q: What benefits have collaboration between medicine and industry brought to surgical treatments, and what do you see as the future possibilities and challenges?

A: I believe in the importance of collaboration between medicine and industry. At the Japan Society for Endoscopic Surgery with which I was involved in 2012, we set up the first plaza for medicine-industry collaboration in the form of an exhibition space where surgeons, researchers, and companies exchanged views face to face. Currently, there are numerous initiatives underway for strengthening collaboration between medicine and industry, including the "Monozukuri Commons" which provides a forum where companies and physicians can meet at different places. The Japan Society for Endoscopic Surgery is also working on a variety of projects.
As I believe there would be no advances in endoscopic surgery were it not for collaboration between medicine and industry, increasing the number of such forums in the future is significant for all parts of the medical equipment industry.
I have myself been involved in the development of a variety of products since being approached by an Olympus engineer when attending a conference in the early 1990s. While some of these developments never reached the market, I believe that getting doctors and vendor company engineers facing in the same direction and engaging in debate is vitally important for the progress of medical technology. A good example of this, I believe, are the THUNDERBEAT energy devices, world-first products that combine bipolar high-frequency current with ultrasound.
In this way, I am aware that Olympus is striving to identify diverse market needs through discussion with doctors like myself. I look forward to you continuing to develop products that satisfy market needs.

Q: Finally, please tell us your views if there is anything you would like from Olympus in the future?

A: While Olympus medical instruments such as gastrointestinal endoscopes and laparoscopes tend to be completely adequate in a technical sense, I believe there is room for further enhancements by incorporating technologies from outside medicine. The use of wireless technologies such as Bluetooth to eliminate the need for cables in endoscopes, for example, would make them more maneuverable and convenient to use. Similarly, progress on shifting to the cloud servers used for filing endoscope images at each institution would enhance convenience and reduce costs at hospitals.
As a Japanese manufacturer of medical instruments, Olympus is recognized as one of the few companies with the technology to take on the world. In the future, I look forward to you also utilizing the latest technologies from outside the company to further improve your products and services.

Engineer's Interview: This is How we Make Progress on Minimally Invasive Therapy

Manager, Energy 1 Group, Therapeutic Products Department, Medical Product Development Division 2, Olympus Corporation.

Eiji Murakami

One of the two valuable methodologies delivered by the Olympus medical business, minimally invasive therapy reduces the stress on the patient and enhances their subsequent quality of life (QOL). The company's THUNDERBEAT electrosurgical devices used in operating rooms were also developed with this objective in mind. In this article, Eiji Murakami, who has had a long involvement in the development of endotherapy devices and surgical products, including responsibility for the THUNDERBEAT development, tells us about the nature of the minimally invasive therapy provided by Olympus.

Even Shorter Hospital Stays

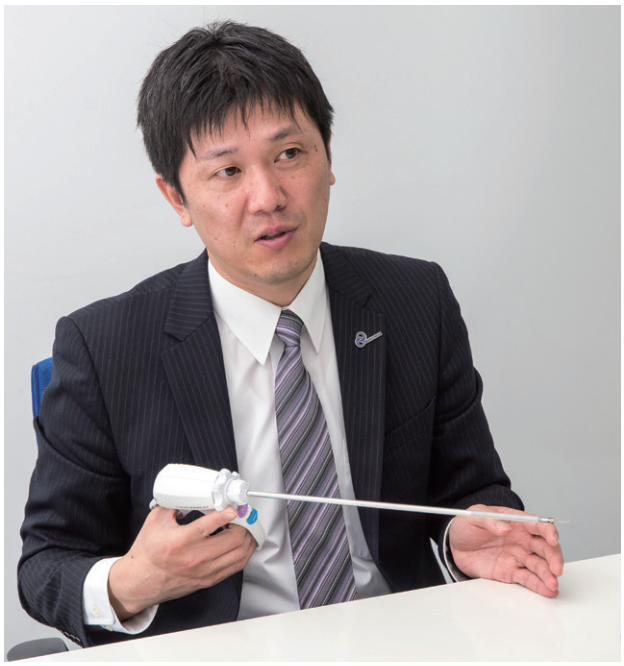
Q: To begin, what is meant by minimally invasive therapy?
A: While definitions vary, the term is generally used for procedures that are less invasive than conventional surgical techniques. The simplest definition is that the extent of scarring to the body is smaller. Also that this results in the patient being more quickly rehabilitated back to society. Yet another definition is to complete a procedure more quickly to reduce the stress on the patient. Also, to be able to receive hospital treatment at lower medical cost. I think all of these things together make a minimally invasive therapy.
Q: Endoscopic surgery is a typical example of a minimally invasive therapy. In what ways is it less invasive than conventional surgical techniques?
A: Conventional techniques often involved subjecting the patient to highly invasive procedures such as making a large incision in the abdomen, or the severing of rib bones in the case of chest operations. For various conditions, the widespread adoption of endoscopic surgery has seen these replaced by minimally invasive therapy and I believe this has lowered the barriers to people undergoing surgery. It has shortened the month-long hospital stays associated with laparotomies, for example. Depending on the nature of the case, it has become a matter of course for patients to be back to their normal lives one week after their operation.

Technology Advances in Collaboration with Doctors

Q: How has the field of endoscopic surgery made considerable progress since the early days?
A: Operating times have shortened and the stress on patients has been reduced. Gastric resections, for example, typically used to take five or six hours, whereas now they are often completed in three to four hours. While this is in a large part thanks to advances in doctors' skills, I believe that the improvements to medical equipments have also played a part.
Q: In other words, you made advances in tandem with doctors?
A: That's right. When developing medical equipment, it is only by working closely with doctors that we can deliver high quality and minimally invasive surgery to their patients. Unless the end result is more effective in a medical sense, such as being less invasive, there is no point in simply seeking to improve device performance and developing products that are designed specifically for cutting or holding and nothing else. There are aspects that only a doctor can judge, therefore, it is essential that we work in collaboration with doctors to verify product benefits.

Strength of Doctors' Concern for Patients

Q: Does minimally invasive therapy have advantages for doctors?
A: While it may be less invasive for the patient, essentially endoscopic surgery makes life more difficult for doctors. For example, the way doctors must keep in mind risks such as hemorrhaging while viewing a video monitor with a limited field of view means the work is more stressful than open procedures like laparotomy. Choosing a minimally invasive therapy should not lead to any drop in the effectiveness or quality of surgery. Numerous measures have to be taken to find ways of



maintaining the effectiveness of treatment at the same level as conventional methods. For example, operations for stomach or colon cancer resection require lymph node dissection, a measure to prevent recurrence. We need to ensure that a doctor can perform this procedure through endoscopic procedures with the same accuracy as in an open laparotomy that gives a direct view and allows doctors to feel with their hands. Our job is to assist in making this a reality.

Q: Given the pressured and stressful environment you have described, what is it that motivates doctors to give these techniques a try?

A: I believe it comes down to concern for their patients' quality of life. They are motivated by a genuine desire to find ways of providing treatments that place less stress on the patient. A common comment from the doctors that we receive during product development is that even a 1% reduction in the rate of cancer recurrence is worth pursuing, and this point cannot be compromised, even in the case of minimally invasive surgery. For ourselves, we appreciate that we need to develop devices that satisfy this requirement.

Meeting Doctors' Need to Act for Patients' Benefit

Q: What do you believe is the best way to respond to this enthusiasm among doctors?

A: Unlike gastrointestinal endoscopes, Olympus got into the surgical business, particularly therapeutic devices, at a later period. We started as a market follower and have developed our products by adding minor enhancements to differentiate them from what was already available on the market. However, we came to realize that this would not deliver the level of surgical quality that doctors were seeking. An important factor in the creation of superior products, I believe, is that we pursue what is needed to genuinely satisfy doctors' needs. While one point of emphasis in our development is to provide doctors with ideal treatments they can use without stress, we also need to meet the doctors' objective of making these treatments less invasive for the patient. In other words, to provide treatments that are more effective in medical terms. In my view, we will be able to become a market leader when we become capable of offering such value.

Q: How do you deal with after-sales service, training, and other support for doctors?

A: To ensure that therapeutic devices are used safely, we need to provide users with precautions and instructions for use. Particularly in the case of entirely new products like THUNDERBEAT, this activity is even more important than in the past. Including for THUNDERBEAT, we are establishing mechanisms with which we work with marketing department to prepare materials that describe usage and precautions, and then our sales force in each market use them as the sales training tool. We hold regular meetings with marketing sections to exchange information, and provide follow-up on technical information when required.

THUNDERBEAT Combines a Hemostasis Function with Unprecedented Cutting Speed

Q: Can you describe the new products you developed in more detail? The THUNDERBEAT is a unique surgical energy device that our competitors don't have. What makes THUNDERBEAT special?

A: The most distinctive feature is the operating mode that simultaneously generates both ultrasonic energy for coagulation and cutting and bipolar high-frequency energy for hemostasis and sealing of blood vessels. Whereas separate specialized instruments were needed for these procedures in the past, we have now combined the functions into a single device. As a result, THUNDERBEAT offers an unprecedented cutting speed and reliable hemostasis function. By enhancing the performance

of basic procedures such as grasping or dissecting tissue, we have been able to develop a single instrument that can be used for a wide range of purposes. We anticipate that this will significantly reduce the number of times instruments are switched during surgery, consequently shortening operating time and relieving stress on the doctor.

Q: In realizing this product concept, what difficulty did you face during development?

A: The hemostasis function is strongly influenced by the device specifications. We put a lot of design effort into the question of how to satisfy the conflicting requirements of effectively sealing blood vessels while at the same time achieving fast cutting. It is not something that can be achieved simply by combining the two forms of energy, We spent a long time to study various tip shapes and energy output conditions before we successfully realized the product concept.

Q: How does the performance of THUNDERBEAT contribute to providing minimally invasive therapy?

A: I expect that reliable hemostasis helps prevent complications such as bleeding during or after the operation. Also, by realizing improved surgical efficiency, such as procedures being performed more quickly and less switching of instruments, operating time gets shorter and the stress on the patient as well as on the doctor is reduced. Once doctors become accustomed to the faster surgery made possible by THUNDERBEAT, they would not be satisfied with surgery performed with conventional instruments.

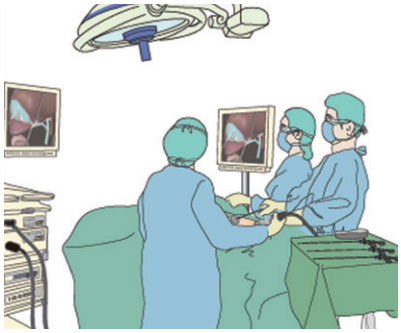
Numerous Developments Targeted by Minimally Invasive Therapy

Q: Please tell us about the future direction of device development for advancing the field of minimally invasive therapy?

A: Just as we have applied technologies developed for the endotherapy devices used with gastrointestinal endoscopes to endoscopic surgery devices, for example, we believe we can also apply technologies from endoscopic surgery in open laparotomy. Since endoscopic surgery is complex and difficult, progress is being made on technologies to make devices easier and faster to use. If these devices can also be used in laparotomy, I believe they can help make the procedure less invasive by shortening operating time.

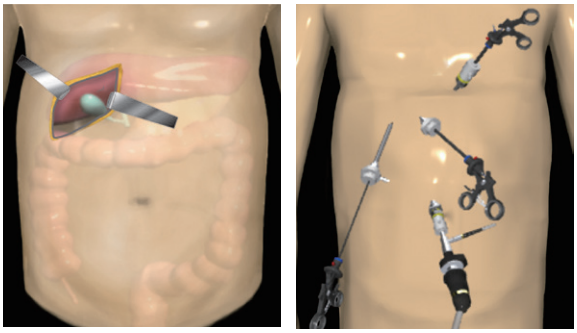
Naturally, we are also looking to develop new devices that will allow endoscopic surgery to be used for cases that, currently, can only be operated on by laparotomy. For example, as endoscopic surgery is still only used for about 30% of stomach cancer operations, we are developing devices that will allow half of the remaining 70% to be done endoscopically, and also devices that will allow the other half that continue to be performed by laparotomy to be done with minimally invasive techniques. Another line of device development is aimed at making procedures already performed under endoscopy even less invasive. As these examples demonstrate, we continue to work on a wide range of technical developments.

The History of Endoscopic Surgery



Endoscopic surgery

Comparison of gallbladder removal surgeries



Laparotomy　　Endoscopic surgery

Development of Surgical Techniques

Surgery is only one means of treating an injury or curing a disease. In ancient times, the primary treatment for medical problems was "internal medicine," where people were treated with drugs without having surgery. Using a scalpel only brought danger and pain. However, since the 19th century, anesthesia, blood transfusions, and disinfection practices have been developed, and technology such as antibiotics has evolved to protect the condition of the patient during and after surgery. Surgery has since become a main discipline on par with internal medicine.

Nevertheless, surgery is still encumbered by the problem of its tremendous "assault" on the human body. The medical term is for this is "invasiveness." With most surgeries the patient not only has to recover from the intended procedure (such as removal of the gallbladder) but also from the accompanying procedure (such as making a large incision in the abdomen in order to gain access to the gallbladder). Often the incisions required to obtain access to the organ to be operated are the main reasons for the patient's lengthy recovery.

Endoscopy Brings a "Revolution"

What brought about a recent "revolution" in surgery was the development of "endoscopic surgery," a kind of surgical treatment that makes use of an endoscope for access.

As opposed to existing laparotomy and thoracotomy procedures, endoscopic surgery is a new kind of surgery that requires only a few small holes to be made in the skin of the abdomen or chest. It is performed using long-shafted forceps, electric scalpels and other hand instruments while viewing the inside of the body through a laparoscope or a thoracoscope (endoscopes for viewing the abdomen and chest). The reason why endoscopic surgery is so revolutionary is because it greatly lowers the invasiveness of surgical treatment, while at the same time greatly increases the patient's quality of life (QOL).

The history of endoscopic surgery goes back to 1910, when thoracoscopes were used in the treatment of pulmonary tuberculosis. In the 1960's endoscopes were being used in the fields of urology and gynecology in Europe. They became a common way to treat urinary tract stones.

In 1978, the German surgeon Kurt Semm developed an automatic insufflator (a device that pumps carbon dioxide gas into the abdominal cavity in order to expand it and create a space for observation and surgery). This device greatly facilitated his performance of endoscopic gynecological surgery.

The Accomplishments of Mouret

In 1985, the German surgeon Erich Muhe performed an endoscopic gallbladder removal.

However, the man who was instrumental in the spread of endoscopic surgery on the gallbladder was the French surgeon Philippe Mouret. In 1987, he performed a gallbladder removal by attaching a CCD camera to the laparoscope and projecting the resulting video image on a TV monitor. He established the current style of laparoscopic surgery where the surgery is performed cooperatively under the shared vision of doctors, assistants, and engineers.

The first endoscopic gallbladder removal in Japan was performed in 1990 by Professor Tatsuro Yamakawa of Teikyo University. Starting in 1991, endoscopes were being used to resect the stomach for the treatment of stomach cancer.

Since the early 1990's there have been many technological advancements in addition to the accelerated clinical use of endoscopic surgery. As stated previously, a key development was the coupling of endoscopes to external CCD cameras. The ability to view the operation on a video monitor allowed for a high level of cooperation between doctors and their assistants. The development of devices and equipment for surgery in body cavities that cannot be reached directly by hand progressed rapidly.

Post-operative scars are small

Olympus Medical Training Center
(Hamburg, Germany)

Olympus Surgical Technologies America
(Massachusetts, U.S.)

Shortened Hospitalization

Endoscopic surgery has many advantages over open surgery. First, for the patient, post-operative scarring is typically much less compared to laparotomy. Smaller incisions usually lead to less time spent in the hospital and a faster return to work. Shortened hospitalization periods reduce the financial burden on private payers, insurance companies and government supported healthcare systems.

Obviously, for a doctor to perform a revolutionary new procedure he must learn a brand new set of skills. However, there are benefits to him as well, such as being able to magnify the target area and the ability to access organs that are deep in the body and that are therefore difficult to access via open surgery (e.g., kidneys). Compared with prior surgical methods where it was difficult for all to see what the surgeon's hands were actually doing, endoscopy makes it easier to train young doctors by using the video monitor to show the surgical process. The numerous benefits of endoscopic surgery, which outweigh its disadvantages, are driving its popularization.

Health Insurance Coverage Starts in 1992

In Japan, starting in 1992 with gallbladder removal, endoscopic surgery is rapidly becoming covered by health insurance. Hernioplasty, lung resection, and gynecological surgeries were covered by health insurance starting in 1994, stomach resection in 1995, and 18 surgeries including splenectomy and liver removal in 1996.

Categorized by the parts of the body, 49 techniques for the gastrointestinal system, 14 for the respiratory system, 25 for gynecology, 46 for urology, and 14 for ear, nose, and throat have been approved for use under Japanese health insurance. Work is also in progress on applications to other parts of the body.

Activities aimed at spreading endoscopic surgery are also popular in Japan. The Society for Endoscopic Surgery was started in 1990, and the Japan Society for Endoscopic Surgery (JSES) was established in 1995. The goals of these societies include both research and education. As of July 2008, membership was around 10,000. These societies foster increased awareness of endoscopic surgery through various conferences and publications, and certify technical competence in these new procedures through their physician certification programs.

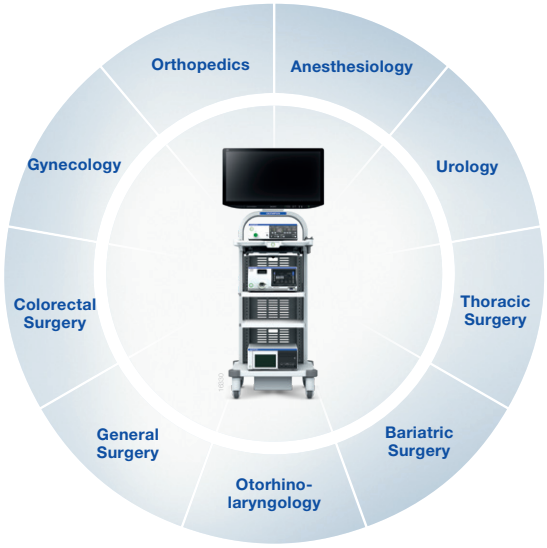
Olympus and Surgery

Olympus had already by the end of the 1960's anticipated the use of endoscopes in surgery. In 1979 we increased our capabilities in this field by acquiring the German rigid endoscope manufacturer Winter & Ibe. Since then, Olympus has introduced innovative products, including surgical endoscopes with high-definition imaging and the world's first surgical energy device that can simultaneously generate both high-frequency electric current and ultrasonic vibrations.

Endoscopic Surgery Systems and Devices

A Broad Product Line is Key

Equipment used in endoscopic surgery can be roughly divided into 3 groups: 1. Endoscopes, 2. Video processors and light sources, 3. Instruments such as electrosurgical knives. As open surgery is gradually being replaced by endoscopic surgery, the sophistication of endosurgical equipment has increased.



Endoscope

There was a time when all surgical endoscopes were metal tubes containing multiple lenses. However, these are being replaced by videoscopes that employ CCD image sensors in their tips, due to the increased sharpness of their image and their improved ease of maintenance.
In general, videoscopes have a diameter of 5mm and a length of 320-370mm. 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 scope

Rigid Endoscope

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


Telescope


Ear and nose / Otoscope


Urology / Resectoscope


Arthroscope

Video System Center

The unit both 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. Olympus products are notable for their image enhancement achieved by using opto digital techniques such as Narrow Band Imaging (NBI). A feature of the models sold in Europe and U.S. is that they can work with both rigid and flexible scopes.


Video System Center

Insufflator

A necessary part of endoscopic surgery is requirement for an 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

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 available in diameters ranging from 5-15mm. Currently, the most common trocars come with a sheath and are single-use

Trocars

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.

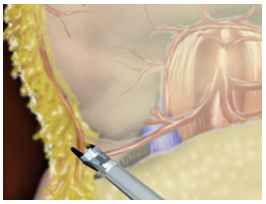

Forceps

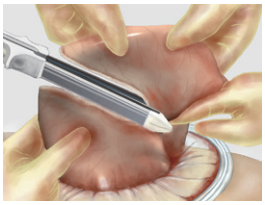

Tip of grasping forceps


Tip of dissecting forceps

Hemostasis Clip, Surgical Stapler

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.
A surgical stapler is a device that can create two rows of staples (3-6 cm in length) and then cut the tissue between these rows, all in one motion. In the tip of the instrument is a cartridge containing the staples and an automatic knife blade. When the handle is squeezed, the staples are fired and the tissue is cut and separated, all at the same time.


Hemostatic clip (image)


Endoscopic stapler (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 current 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)

New range of THUNDERBEAT models, the world's first and fully-integrated bipolar/ultrasonic energy devices

THUNDERBEAT Open Fine Jaw for open surgical procedures

Designed to be smaller and lighter than previous models, the fine tip shape and ergonomic grip of the new model enable more exacting surgery to be performed. Open Fine Jaw is used in all areas of general surgery, including gastrointestinal area.


THUNDERBEAT Open Fine Jaw

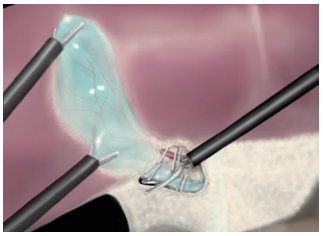

Output Unit

Examples of Endoscopic Surgery

Ever since Dr. Mouret of France performed a gallbladder removal endoscopically in 1987, endoscopic surgery has spread to a number of fields. Research and application of endoscopic surgery is currently progressing in the digestive tract, the respiratory system, the urinary system, the field of otorhinology and gynecology, etc. This chapter will introduce some representative examples of this kind of surgery.

Laparoscopic Cholecystectomy

This is the most common type of endoscopic surgery in Japan, with approximately 26,000 cases being performed each year. It is typically performed for benign gallbladder problems, such as gallstones, polyps in the gallbladder, adenomyomatosis of the gallbladder, etc.
The gallbladder is attached to the underside of the liver, and must be carefully removed using an electrosurgical knife and dissecting forceps. Next, the cystic artery and cystic duct are clamped with clips and cut to separate them from the liver. Finally, a trocar is inserted and the gallbladder removed from the body through the trocar using grasping forceps.

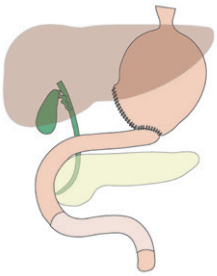


Detachment of gallbladder

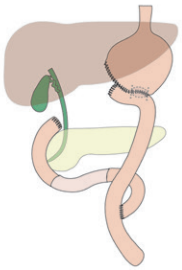
Removal through incision

Laparoscopy- Assisted Distal Gastrectomy (LADG)

This surgery is limited in application to early-stage cancers from the lower part of the stomach (pyloric antrum) to the middle of the stomach (body of the stomach). The standard procedure is to remove at least two-thirds of the stomach and the lymph nodes around the stomach. The reason this is called a “laparoscopy-assisted” procedure is that the surgery requires a laparotomy, albeit with a smaller incision.
The two basic methods for reconstructing the stomach are the Billroth I method and the Roux-en-Y method. In the Billroth I method, the remaining stomach and the duodenum are joined. In the Roux-en-Y method, the remaining stomach and the jejunum are joined, and the remaining duodenum is connected to the bottom of the jejunum. Food flows from the stomach to the jejunum, where it mixes with digestive fluids that flow in from the duodenum.
If these surgeries are not appropriate for the patient, there is still another kind of stomach cancer surgery called Laparoscopy-Assisted Total Gastrectomy (LATG).



Billroth I method



Roux-en-Y method

Laparoscopy-Assisted Colectomy

Colorectal cancer surgeries target the large intestine, cecum, and rectum. As with stomach cancer, the goal of these surgeries is to remove the affected area as well as the associated lymph nodes.
Compared to the stomach, the structure of arteries and veins supplying the colon is simple and the removal of associated lymph nodes is easy. Therefore, it is said that there is a high chance that laparoscopy-assisted colectomy may become the standard surgery for colorectal cancer in the near future.

Nissen fundoplication

Nissen fundoplication is a surgery for treating Gastroesophageal Reflux Disease (GERD). GERD is a disease characterized by heartburn, chest pain, bitter taste in the mouth, etc., caused by the reverse flow (reflux) of stomach fluids back up the esophagus. A laparoscope is used to surgically create a fold around the esophageal sphincter to prevent the reverse flow of stomach contents.

Pulmonary Resection

Lung cancers are now being surgically resected using endoscopes. Thoracoscopic partial lung resection surgery can be performed for removing tumors smaller than 3cm in diameter, and lung lobectomies performed for treating areas greater than 4cm in breadth.

Endoscopic Sinus Surgery (ESS)

A minimally invasive therapy for treating sinusitis (empyema) in which chronic inflammation of the paranasal sinuses (cavities enclosed in bone located near the nasal cavity) causes them to fill with pus and contaminated mucosas. Endoscopic sinus surgery uses an endoscope to provide a view inside the nose while using a debrider (a surgical instrument for removing abnormal tissue with simultaneous use of suction and cutting) to perform treatment.

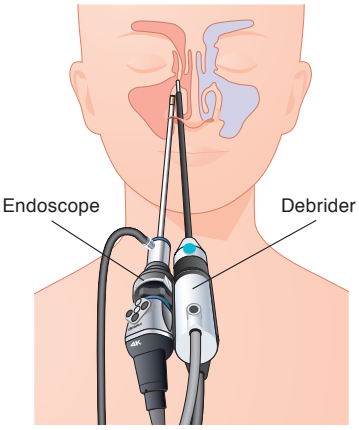


Image of Endoscopic Sinus Surgery

Transurethral Ureterolithotripsy (TUL)

A minimally invasive therapy for treating urinary stone, a condition in which substances contained in urine crystalize for some reason and coalesce in the form of a stone. It involves inserting a thin endoscope via the urethra and breaking up the stone in the urinary tract or kidney using a device for this purpose that works by laser. Once broken up, the stone is removed from the body using stone retrieval baskets.

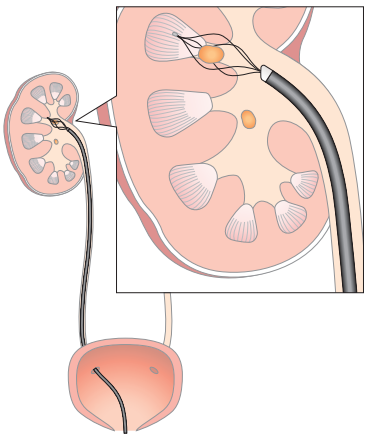
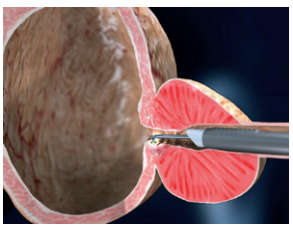


Image of removing stones with stone retrieval baskets

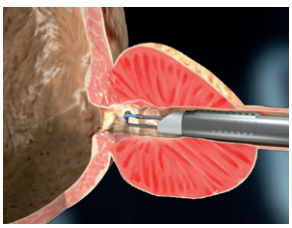
Prostate Resection or Ablation

Prostate resection is a minimally invasive therapy for the male affliction of Benign Prostate Hyperplasia (BPH) This procedure inserts a scope into the urethra and removes the enlarged prostate by scraping with a bipolar electrode or other instrument, or shrinks it by ablation.

Example of prostate ablation



A resectoscope is inserted transurethrally in the vicinity of the neck of the urinary bladder



Ablation of enlarged prostate

Others

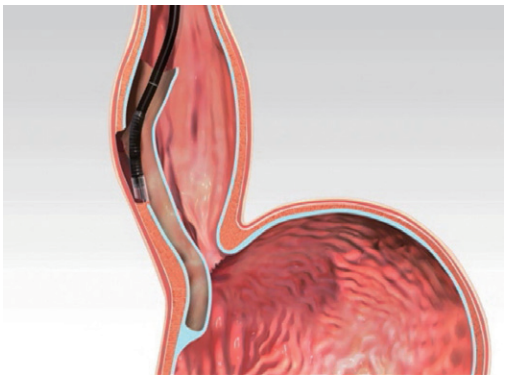
Procedures performed using endoscopes include nephrectomy (kidney removal) in urology, and endometriotic lesion removal, enucleatic myomectomy, and hysterectomy in gynecology.

Less Invasive Methods

POEM (Per-Oral Endoscopic Myotomy)

The development of less invasive surgical methods is progressing rapidly. One example is per-oral endoscopic myotomy (POEM), which is becoming recognized as a treatment for esophageal achalasia. Previous treatments were to take a calcium antagonist orally, balloon dilatation, or laparoscopic surgery in which part of the muscle layer from the esophagus to the stomach was removed. POEM is a new minimally invasive therapy that uses an endoscope to cut the muscle layer of the esophagus to improve the difficulty swallowing in the esophagus, and therefore does not leave any scar on the exterior of the body.

Note: Esophageal achalasia is a condition that results in problems such as obstruction in the passage of food or the stretching of the esophagus due to its peristaltic action (the action by which food is moved along the esophagus) being obstructed such that the sphincter at the bottom of the esophagus (esophageal muscle at entry to stomach) does not fully open.



POEM

Other Initiatives

OR Integration

This means integrated surgical systems that have the effect of reducing stress on medical personnel and help endoscopic surgery proceed more smoothly through the use of centralized control to combine the operation of a number of instruments. With healthcare reform taking place around the world and a greater focus being placed on enhancing the efficiency of hospital management, OR integration provides a functional and efficient surgical environment.

GI in OR

This seeks to ensure that surgery is performed safely and efficiently by, for example, the use of a gastrointestinal endoscope during endoscopic surgery such as resection of the stomach or colon to visually check the surgical anastomosis, or to make follow-up observations after surgery. The endoscopic systems that Olympus supplies in Europe and U.S. have a major advantage over competing products because they are designed to also allow the connection of surgical endoscopes.