

Developing Minimally Invasive Surgery Centers Within Kaiser Permanente: The Integrated Multidisciplinary Experience of Los Angeles

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Abstract

Minimally invasive surgical therapies are growing in type and volume of interventions. As one of the largest health delivery organizations in the US, Kaiser Permanente staff must be aware that the proliferation of these technologies has occurred in parallel within many surgical specialties, with a large variation in level of implementation between different regions and even within regions. In Los Angeles, we have developed the Minimally Invasive Surgery Center, encompassing a multidisciplinary, integrated approach. It unites the effort and expertise of many outstanding practitioners within the organization and consolidates the achievements of many surgical specialties. It also brings together the elements needed to provide the highest level of care to our patients in a safe, efficient, cost-effective environment, with minimal morbidity and best long-term outcome.

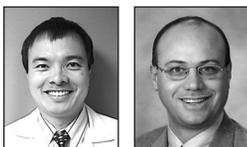
Introduction

Surgical procedures and interventions remain an important cornerstone of modern health care and contribute to the care of millions of individuals in the US every year. Surgery is invasive and often requires large soft-tissue incisions to gain access to diseased organs and compartments of the human body. Although the morbidity of a procedure is determined by its nature and that of its target organ (eg, bone, brain, bowel, urologic tract, gynecologic organs), the invasiveness and magnitude of the soft-tissue incision is one of the determinants of postoperative recovery, complications, length of hospital stay, pain,

and eventual resumption of normal daily activities.

Since the 1980s, the surgical fields have been in a revolutionary phase with the development and implementation of new technologies and procedures that have provided surgeons across many specialties with an armamentarium of less-invasive therapies. Many conditions traditionally approached with open surgery are now treated by alternative means.¹⁻²² Minimally invasive surgery (MIS) can address many disease processes by allowing the surgeon access to the area of interest through smaller incisions that are at lower risk of morbidity. The advantages and benefits as-

sociated with MIS have translated into fewer complications and less morbidity for the patient without compromising the principal goal of surgical therapies, which is the eradication or control of disease (eg, removal of an inflamed gallbladder, ablation of endometriosis, excision of colon cancer, repair of an aortic aneurysm, evacuation of a herniated vertebral disc, elimination of gastroesophageal acid reflux). As experience with MIS has evolved—and is still evolving—there has been rapid growth in both the types and volume of such surgeries performed, with a shift from simple procedures such as hernia repair to more complex and advanced procedures such as gastric bypass and radical prostatectomy, partial nephrectomy, and cystectomy.⁷⁻¹² Many MIS techniques have now become the standard of care (eg, cholecystectomy for cholecystitis, splenectomy for hematologic disease, adrenalectomy for adrenal tumors, transsphenoidal resection for pituitary tumors, arthroscopic shoulder surgery for rotator cuff injuries, endovascular therapy for aortic disease), but other procedures increasingly compete with open surgery for percentage volume of cases and a growing number of indications



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(eg, colectomy for diverticulitis or colon cancer, hysterectomy for fibroids or malignancy).^{1,3,4,14}

Several new, advanced MIS techniques are being implemented, are under development, or are being investigated for technical feasibility and results.¹⁵⁻²⁶ Research is currently underway to evaluate the results of MIS for oncologic disorders such as rectal cancer.^{15,16} Robotic surgery is gaining momentum in the US and other countries as more data are collected on short- and long-term outcome and its potential role in and impact on pelvic surgery for urologic, gynecologic, and colorectal conditions as well as foregut and thoracic surgery.^{6,18-22} Kaiser Permanente (KP) recently introduced robotic surgery in its Southern and Northern California Regions and is closely monitoring the effects of this evolving technology. Finally, active investigation is underway to assess the technical feasibility, safety, and outcome of single-port surgery (accessing the abdominal cavity and performing abdominal surgery assisted by a device through a single 2-cm umbilical incision) and of natural orifice transluminal endoscopic surgery ([NOTES] accessing the abdominal cavity through a puncture in the stomach, rectum, or vagina and performing abdominal surgery through a flexible endoscopic device).^{17,23,24} Research in these emerging areas will yield innovations, new technologic advances, and new tools.

Rapid Growth in Volume of Advanced Minimally Invasive Procedures

KP embraced the MIS revolution from the beginning. Some KP hospitals got involved with the introduction and implementation of these new procedures early in their development. For example,

the San Diego facility in Southern California pioneered some of the MIS procedures to advance the care of patients with intestinal and abdominal conditions.²⁷ Since the early 1990s, surgeons at the KP San Diego Medical Center have performed numerous laparoscopic colonic resections. Their surgical skills have benefited not only KP San Diego patients but also patients across the US through their contributions as surgery educators at many symposia and conferences. More recently, the West Los Angeles Medical Center in Southern California implemented robotic surgery for radical prostatectomy. Within a short time, our group of urologists has performed one of the largest series of patients at both the national and international levels. Our collaboration has yielded comprehensive short-term outcomes and a model of efficiency for future expansion of robotic surgery within KP. Although noting all MIS advances at a regional or national level is beyond the scope of this article, we note that KP physicians both inside and outside the Southern California region are responsible for many MIS achievements.

Across KP nationally, the growth of advanced MIS procedures was gradual in the 1990s, but there has been a rapid surge in volume in the first decade of the 21st century. This phenomenon stems from several factors: influx of a large number of fellowship-trained surgeons with advanced MIS skills, the increasing availability of surgical tools and technology to perform such operations, proliferation of outcomes data demonstrating the benefits of MIS, patients' demands, and an institutional commitment to provide state-of-the-art care to patients.

Our own experience at the Los Angeles Medical Center (LAMC) illustrates the growth in MIS practices

within KP. Our institution serves as the regional tertiary center for all hospitals within Southern California and occasionally provides extraregional care to patients from the Hawaii and Northwest regions. Since 2003, we have witnessed swift growth in the number of MIS procedures across many specialties at LAMC: for instance, the volume of advanced laparoscopic urologic procedures has increased more than tenfold, and the percentage of colorectal excisions performed with laparoscopic or endoscopic techniques has increased from <5% in 2003 to >60% in 2008. Currently, pediatric surgeons perform 40% of their procedures in children using MIS techniques; a few years ago, none of them used MIS. Orthopedic MIS procedures for upper-extremity conditions such as rotator cuff injury, unstable joints, and contractures represent >60% of the total volume of cases. Within the field of neurologic and spine surgery, approximately 100 MIS procedures are performed at LAMC every year. Finally, there has been a major shift in the MIS training and expertise of the staff in the various surgical subspecialties at our medical center. Within the Department of Surgery (general surgery and its subspecialties), for example, the percentage of surgeons offering advanced MIS procedures (laparoscopic, endovascular, endoscopic) grew from 18% (2 of 11 surgeons) in 2003 to 71% (12 of 17 surgeons) in 2008.

The Need for Multidisciplinary Minimally Invasive Surgery Centers

The implementation of new technology and growth in MIS procedure volume has benefited both patients and the health care system but has also presented many chal-

lenges. Different procedures have been established at different times and have been implemented at different rates within KP because of the gradual evolution of the technology. Furthermore, the introduction and promotion of MIS procedures within KP has been driven by individual surgeons in various specialties

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according to their interest level, training, and expertise. In most instances, the implementation of these new procedures has been fragmented, with large variation in practice patterns among surgeons in the different regions and even within the same region or medical center. Despite leadership support and commitment to MIS, there has not been a systemic approach to MIS implementation at a local, regional, or national level. Medical

centers have not optimized the introduction of these new procedures. Furthermore, each subspecialty has its own learning curve. Often, the different surgical subspecialties do not share resources, consolidate accumulated experiences, or exchange information on best practices to make the learning curve less steep and resolve the challenges of developing and implementing new technology. Although there are unique issues for each specialty, many common issues, such as anesthetic considerations, organizing operating room teams for MIS, standardization of disposable products and electrosurgical units, testing and implementation of new equipment, postoperative care, education, simulation, training, and research, could be effectively

and efficiently addressed through a multidisciplinary approach.

There are numerous unresolved issues, at KP and elsewhere, surrounding the care of patients treated with MIS procedures: There is an ongoing debate of how to best train residents, fellows, and practicing surgeons not proficient in advanced MIS techniques. Additionally, there is no consensus as to how best to proctor or credential physicians requesting privileges for MIS procedures.²⁹⁻³⁰

Also, changes in the operating room environment are particularly stressful for surgeons and supporting nursing staff. The majority of practicing scrub and circulating nurses are skilled at assisting in open procedures. For more than 100 years, surgical nurses and technicians have received extensive training on how to best assist surgeons to perform traditional procedures. The nursing surgical heritage and knowledge of instrumentation and equipment have been transmitted from one generation to the next in nursing and technical schools and perfected in operating rooms everywhere. Therefore, many support personnel lack the skills set necessary to effectively assist surgeons with MIS techniques. Our experience has been that most operating room nurses and technicians have been acquiring the necessary experience on the job, a process that is often stressful and frustrating to the surgeon and costly to patients and institutions because of decreased efficiency, increased duration of surgery, and thus increased fees. Furthermore, labor regulations and considerations affect staffing and logistical issues. Finally, a shortage of nurses in the US has affected the operating room at several levels. However, unlike surgeons, who have increasingly taken up subspecialties, with focused expertise

in, for example, shoulder, spine, or sinus surgery, the majority of nurses are expected to assist with all subspecialties of surgery. The discrepancy in level of expertise between the surgeon performing an advanced MIS procedure and supporting personnel can often affect both patient well-being and the efficiency of the operating room.

In addition to these human factors, the physical environment in which we practice can also contribute to some of the daily difficulties encountered. Our group practices in high-quality, well-equipped hospitals, but many of our facilities were designed and built before the MIS revolution. Existing operating rooms have plenty of space to allow for the conduct of traditional open procedures but not for MIS procedures, which require additional equipment (eg, monitors, electrosurgical units, fluoroscopic machines, robotic equipment) that in turn requires additional time for setup, retrieval, and troubleshooting.

Clearly a system-based approach is needed to maximize the efficient and safe integration of advanced MIS technology within health care systems such as KP. Although individual surgeons can make significant contributions to the process of establishing MIS programs, we have reached a point in the history of surgery where an infrastructure is needed that can both support existing practices and accommodate the proliferation of future technology. Collaboration is needed at all levels: surgeons, anesthesiologists, nurses, technicians, administrators, and educators. A new platform needs to lay the foundation for addressing the continuing and emerging needs of MIS. We must evolve from a surgeon-driven process to a team- and system-based process. The value of an operating

room team approach has been well established and validated in several studies,³¹⁻³⁶ but it is important to keep in mind that operating room teams are only one of the critical elements necessary to successfully support MIS practices. MIS Centers are required to serve as umbrella structures to address the needs of MIS at several levels.³⁷

Organizing Minimally Invasive Surgery Centers Within Kaiser Permanente: The Los Angeles Experience

The changing nature of surgical practices at our tertiary referral center at LAMC and the increasing number of practitioners offering advanced MIS procedures have led us toward a multidisciplinary approach to address challenges. To fulfill the needs of surgeons providing MIS and patients seeking it, LAMC launched an MIS Center. Originally we set up an MIS committee to address the implementation of new technology at our facility. Recognizing that this endeavor addressed only one aspect of MIS, we expanded the focus to a multidisciplinary MIS Center that would tackle all facets of MIS care at our institution and might also serve as a regional and national integrated model of MIS within KP. The mission of our Center of excellence is to support the clinical practices of MIS surgeons, to offer state-of-the-art care for our patients, to provide education opportunities through residency and fellowship training programs, and to advance the science of MIS through research and innovation. To fulfill this mission, we have assembled a team of experienced surgeons and nurses to guide the development, growth, and direction of the Center.

It is important to point out that there has been a rapid proliferation of MIS Centers of excellence within the US since the mid-1990s. Unfortunately, many of these centers are driven by marketing and financial considerations and rarely represent collaborative efforts to address the needs of MIS. Although some of these centers have clinical value, most are promoted by an individual practitioner or a small group of same-specialty surgeons as a vehicle to increase practice revenues. Whether for gastric bypass for obesity, spine surgery for disc disease, or radical prostatectomy for cancer, advertisements for such centers are ubiquitous on the Internet, on television, in newspapers and magazines, and on radio. In reality, there are few comprehensive multidisciplinary MIS Centers nationally or internationally.³⁷

KP's "secret" for success is its complete integration. Using this platform, LAMC has developed and integrated a multidisciplinary approach to MIS. Our multispecialty group practice, collaborative nature, institutional resources, large patient population, and commitment to provide

the best possible care without any financial incentive provide us with all the elements necessary to pursue this endeavor. In Los Angeles, we invested in these unique features of KP to successfully launch and grow our MIS Center at a local, regional, and national level (Figure 1).

Clinical Practice Initiatives

A significant contributor to the volume and quality of advanced MIS procedures is the expertise and skills of surgeons. At LAMC, the chiefs of surgery and other surgical subspecialties have actively recruited new fellowship-trained surgeons proficient in the delivery of the latest technology. As mentioned earlier, the percentage of MIS-trained surgeons has grown rapidly, paralleled by an increasing amount of collaboration and exchange between the different subspecialties to tackle issues universal to all surgical specialties. The MIS Center at LAMC has served as a forum for exchange of information on best practices and of technical skills. Interpersonal relationships among MIS surgeons have enhanced patient

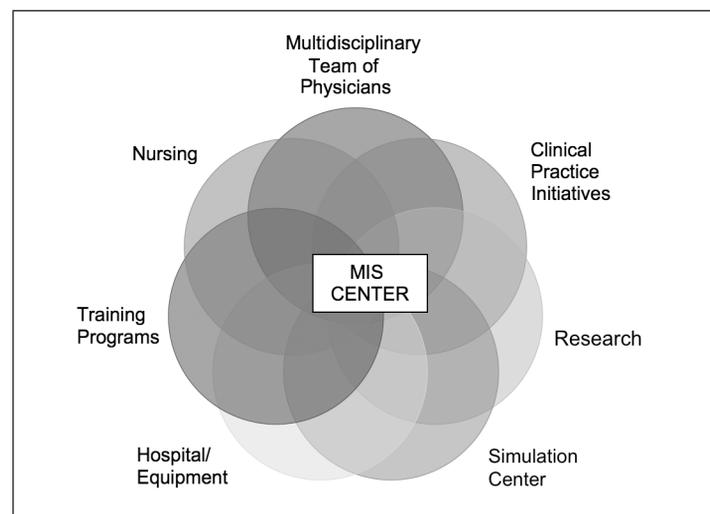


Figure 1. Schematic diagram showing the multidisciplinary integration model of an Minimally Invasive Surgery center.

care, especially when combined specialty procedures are necessary. Furthermore, the lack of financial incentive within our organization has fostered a collegial collaborative atmosphere.

The MIS Center has actively engaged the Anesthesiology Department to encourage an open dialogue to improve the delivery of MIS care within the institution. For instance, an anesthesia colleague serves on our general committee to represent that aspect of MIS care. Several cardiopulmonary and physiologic considerations come into play with MIS techniques such as laparoscopy. Preoperative factors such as baseline comorbidities and body habitus can have a direct impact on intraoperative events (eg, carbon dioxide metabolism, difficulty with ventilation in extreme positions such as severe Trendelenburg for low pelvic surgery). Guidelines for selective preoperative cardiopulmonary testing and evaluation are now being delineated. Surgeons often select a patient for an MIS procedure on the basis of technical feasibility and outcome, which in turn depend on surgical history (eg, presence of scars or adhesions) and disease process (ie, benign, inflammatory, or malignant). Input from anesthesia colleagues as to the fitness of a patient to withstand a prolonged MIS procedure is critical. Many of these procedures require additional considerations such as more time in the operating room, extreme positioning, and physiologic changes. We have solicited their direct feedback through personal interactions, group discussion, and educational activities such as grand rounds on MIS topics led by LAMC surgeons.

As mentioned earlier the increased volume of MIS procedures has affected support personnel as

much as it has affected surgeons. With that in mind, we have approached nursing staff at several levels, from nursing administrators to frontline nurses, to raise awareness about the changing nature of our practices and to solicit their thoughts about ways to enhance operating room efficiency. Several of our MIS surgeons have conducted educational activities for our nurses. In-service training sessions have been conducted regularly with refreshers by surgeons, nurse educators, and industry representatives to review instrumentations and equipment. We have welcomed several nurses as members of our MIS Center and have encouraged their participation in all of our meetings to guide policy. This overture has been much appreciated, and the presence of nurses as partners in the process of advancing MIS at LAMC has been critical. These efforts have culminated in the realization of the importance of the team approach to MIS. Jointly we have created specialty lead positions that oversee the Center's day-to-day clinical activities. The nursing leads are seasoned nurses who provide support to our nursing staff by guiding the setup of cases and being available during procedures should a scrub nurse or circulator need additional help. This has improved operating room efficiency and increased nursing expertise and familiarity with MIS procedures.

Hospital and Equipment

As already discussed, most KP facilities were designed or built before the era of MIS. The equipment needed for the conduct of most advanced procedures has outgrown the physical space needed. In the spring of 2009, LAMC was scheduled to inaugurate its new state-of-the-art tertiary hospital.

The new facility was designed to accommodate current and emerging technologies. All rooms are spacious and fully equipped to support the delivery of advanced MIS. Many of the issues faced in the older generation of operating rooms, such as space constraints, the requirement of extra time to wheel in and retrieve equipment, and maximization of working space, have been addressed. The move into the new hospital will constitute a major milestone in the continuous evolution of the Center.

The delivery of MIS care has been driven by the introduction of new tools and devices that have enabled surgeons to refine and advance their techniques. There has been a steady stream of new technology, most of which has clinical merit. However, the explosion in number of products available on the market has posed many problems: escalating cost, variable efficacy and quality, the added burden of maintaining a larger inventory of products on the shelf, compliance issues with national contracts, and training issues and familiarity of supporting staff with a wide spectrum of disposable instruments. The Center's policy is to support the needs of each individual surgeon within the framework of the organization. Members of the MIS Center are actively involved with the operating room committee and the regional and national product council. Although we encourage being at the forefront of surgical care delivery, we critically evaluate requests for new products and take into consideration available scientific data, cost, volume of use, niche specialty need, and existing approved products. All products are approached from a multidisciplinary angle. When conducting trials with

a new product, surgeons from various specialties are invited to participate and to provide feedback.

Residency and Fellowship Training Programs

Members of the MIS Center are active faculty at several postgraduate training programs at LAMC. MIS has played an increasing role in the education of future surgeons, urologists, and gynecologists. In addition to these three residency programs, LAMC offers an endourology fellowship and is awaiting regulatory approval for a fellowship from KP and the University of California, Los Angeles (UCLA) in pelvic floor and female genitourinary tract reconstruction. Both of these fellowship programs entail MIS training. Residents and fellows are eager to acquire MIS skills. Accreditation and licensing organizations, such as the American Council on Graduate Medical Education and American Board of Surgery, have established graduating requirements that include a minimum number of MIS cases. In 2008, the American Board of Surgery established an additional requirement for all graduating surgeons seeking board certification: certification in fundamentals of laparoscopic surgery (FLS). FLS is a training program jointly developed by the Society of American Gastrointestinal Endoscopic Surgeons and the American College of Surgeons. FLS entails acquiring the basic knowledge and skills required to safely and effectively provide MIS care. FLS education is provided through a Web-based training program and skill practice on training boxes. Certification is obtained by passing a written examination and taking a technical skills test. The purpose of FLS certification is standardization of MIS care within the US and

ensuring that surgeons offering MIS care are qualified to do so. The FLS program has been validated through numerous studies.³⁸⁻⁴² There is ongoing discussion within several national organizations to make FLS certification a hospital credentialing requirement for surgeons seeking privileges for MIS procedures. Eight members of our LAMC MIS Center have already obtained the certification or are seeking it to provide the training needed to our residents and fellows.

Simulation Center

There is increasing evidence of the importance of simulation in training physicians to acquire new skills.⁴³⁻⁴⁷ Simulation can provide many of the necessary skills in a stress-free environment at a comfortable pace and without jeopardizing the safety of a patient. Accordingly, we have designed and developed an MIS Simulation Center at LAMC that is equipped with seven training stations, including a state-of-the-art virtual simulator that provides trainees with various tasks appropriate to their level of training and expertise. Several surgeons have set up a multidisciplinary curriculum that is task oriented (eg, suturing, dissecting, manual dexterity, visualization, trocar placement) rather than procedure oriented (eg, how to perform a hysterectomy). In addition to providing skill acquisition and refinement, the program offers a series of didactic lectures at regular intervals. Finally, performance data and testing are provided as feedback to trainees.

Local, Regional, and National Educational Endeavors

To foster exchange of ideas, knowledge, and expertise of MIS, the Center has launched several educational endeavors. A multidis-

ciplinary lecture series has featured KP surgeons from throughout the Southern California region as well as academic surgeons from institutions such as the Mayo Clinic and UCLA. Diverse topics have been discussed, including instrumentation in spine surgery, operating in a liquid environment such as the knee, endovascular therapies, evolution of robotic surgery, and laparoscopic pelvic surgery. We have invited several visiting professors from prestigious academic institutions to join us for a two-day visit to share with them our work and to benefit from their expertise in MIS.

In 2009, the Center, in conjunction with surgical colleagues from other regions, held the first annual KP National Multidisciplinary Minimally Invasive Surgery Symposium. It addressed the current and future developments within the field of MIS, including those in the arenas of surgical education, simulation, natural orifice surgery, single-port surgery, and robotics. Leaders in academic surgery joined us from such institutions as the Mayo Clinic, the Cleveland Clinic, and the Lahey Clinic.

In addition, the Center is launching MIS Web-based education in 2009. The Web site will feature the range of services offered by expert surgeons, patient-education information on pre- and postoperative care, MIS publications by members of the LAMC MIS Center, active research, and a video library of MIS procedures performed by KP surgeons. The Web site will be a venue for all KP surgeons at LAMC, in Southern California, and in other regions to share their expertise. All KP physicians, regardless of geographic location, are encouraged to submit videos and write-ups of their work to the Web site. The contact person is the

author of this article, Gary Chien, MD (gary.w.chien@kp.org). The Web site will also be linked to *The Permanente Journal* Web site.

Research and Publications

Many LAMC surgeons are actively involved in scientific research and serve on committees of national scientific organizations. Numerous recent publications and presentations at the regional and national level have been delivered by members of the MIS Center.^{13,23–26,48–97} These scientific contributions have included developing or refining new techniques, reporting the outcome of MIS procedures, appraising emerging technologies, and establishing treatment and management algorithms.

The MIS Center has played an important role in surgical clinical trials. This involvement established KP as a leading organization at the forefront of scientific research and one of the largest contributing centers to the American College of Surgeons Oncology Group trial ACOSOG Z6051 evaluating open versus laparoscopic rectal excision for cancer. The LAMC MIS center is currently the only KP center nationally enrolling patients in this trial. The results and data generated by this study will guide the future care of thousands of KP patients.

Conclusion

As KP is one of the leaders in health care delivery, it strives to provide state-of-the-art care to its patients in several geographic areas of the US. Surgical interventions represent a significant portion of rendered care and contribute to the well-being of thousands of patients

within the different regions every year. Within KP, MIS therapies are growing in type and volume of interventions. The proliferation of these technologies has occurred in parallel within many surgical specialties, with a large variation in level of implementation between different regions and even within regions. A multidisciplinary approach to MIS unites the efforts and expertise of many outstanding practitioners within the organization and consolidates the achievements of many surgical specialties. Organizing centers for MIS within KP will bring together the elements needed to provide the highest level of care to our patients in a safe, efficient, cost-effective environment, with minimal morbidity and best long-term outcomes. We hope that the integrated multidisciplinary model implemented in Los Angeles will guide the future development of MIS Centers within KP at the national level. ❖

Disclosure Statement

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The Greater Satisfaction

As I sat by the side of this great surgeon [Lawson Tait], a question suggested itself ... Which would give the most satisfaction to a thoroughly humane and unselfish being, of cultivated intelligence and lively sensibilities: to have written all the plays Shakespeare has left as an inheritance for mankind, or to have snatched from the jaws of death more than a hundred fellow-creatures ... and restored them to sound and comfortable existence?

— Our Hundred Days in Europe, *Oliver Wendell Holmes, Sr, 1809 – 1894, poet, physician, and essayist*