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1 ABSTRACT

Recent technological advances in surgery have resulted in the development of a range of new techniques that have reduced patient trauma, shortened hospitalization, and improved diagnostic accuracy and therapeutic outcome. Despite the many appreciated benefits of minimally invasive surgery (MIS) compared to traditional approaches, there are still significant drawbacks associated with conventional MIS including poor instrument control and ergonomics caused by rigid instrumentation and its associated fulcrum effect. The use of robot assistance has helped to realize the full potential of MIS with improved consistency, safety and accuracy. The development of articulated, precision tools to enhance the surgeon's dexterity has evolved in parallel with advances in imaging and human-robot interaction. This has improved hand-eye coordination and manual precision down to micron scales, with the capability of navigating through complex anatomical pathways.

2 INTRODUCTION

Minimally invasive surgery has been established as an important way forward in surgery for reducing patient trauma and hospitalization with improved prognosis. The introduction of robotic assistance enhances the manual dexterity and accuracy of instrument manipulation. Further development of the field in using pre- and intra-operative imaging guidance requires the integration of the general anatomy of the patient with clear pathologic indications and geometrical information for preoperative planning and intra-operative manipulation. It also requires effective visualization and the recreation of haptic and tactile sensing with dynamic active constraints to improve consistency and safety of the surgical procedures. This paper describes key technical considerations of tissue deformation tracking, 3D reconstruction, subject-specific modeling, image guidance and augmented reality for robotic assisted minimally invasive surgery.

2.1 Types of Minimally Invasive Surgery

Advanced robotic systems give doctors greater control and vision during surgery, allowing them to perform safe, less invasive, and precise surgical procedures.
During robotic-assisted surgery, surgeons operate from a console equipped with two master controllers that maneuver four robotic arms. By viewing a high-definition 3-D image on the console, the surgeon is able to see the surgical procedure better than ever before. Computer software takes the place of actual hand movements and can make movements very precise.
Hysteroscopic Surgery
Hysteroscopic surgery is a type of minimally invasive surgery in which an instrument called a hysteroscope is inserted through the cervix into the uterus. The camera on the scope allows the surgeon to see the inside of the uterine cavity. During a hysteroscopic procedure, the doctor can inspect the uterine cavity for

abnormalities such as fibroids or polyps. They can also check the openings of the fallopian tubes.
A hysteroscopic procedure is often done for diagnostic purposes so a gynecologist can inspect the lining of the uterus. The procedure can also be performed to:
Biopsy the endometrial lining
Remove endometrial or cervical polyps
Remove fibroids
Open the fallopian tubes
Endometrial ablation
Remove intrauterine scarring

Video-Assisted Thoracoscopic Surgery (VATS)
VATS is a type of minimally invasive surgery that is used to diagnose and treat conditions in the chest. During the procedure, an instrument called a thoracoscope that has a tiny camera on it is inserted into the chest through one or more small incisions in the chest wall. Other special surgical instruments are inserted as well. The scope transmits images of the inside of the chest to guide the surgeon.

VATS may be used for: Biopsies to diagnose lung
cancer, mesothelioma, and other chest cancers
Lung surgery
Procedures to remove fluid or air from around the lungs
Surgery to treat esophageal disorders
Hiatal hernia repair
Surgery to relieve excess sweating

2.2 The benefits of minimally invasive robotic surgery can include:-

Small incisions
Less pain
Low risk of infection
Short hospital stay
Quick recovery time
Less scarring

Reduced blood loss

2.3 Some conditions treated at Johns Hopkins using robotic-assisted surgery include:-

General – Pancreatic cancer, benign pancreatic lesions, liver tumors (benign and malignant), gallbladder cancer, severe gastroesophageal reflux disease (GERD), obesity (gastric bypass, bariatric surgery, gastric banding)
Lung – Some lung tumors, esophageal cancer and diseases
Gynecologic – Endometriosis, gynecologic cancers (ovarian/cervical cancer), heavy uterine bleeding, uterine fibroids, uterine prolapse, ovarian cysts, benign cervical disorders
Head and neck – Head and neck cancer (oropharyngeal cancer), thyroid cancer
Heart – Mitral valve prolapse and repair, atrial septal defect, atrial fibrillation
Urological conditions – Bladder cancer, kidney disorders (kidney stones, kidney cysts, kidney blockage), kidney cancer, kidney removal, prostate cancer, incontinence, vaginal prolapse
Not all minimally invasive procedures are completed with robot assistance, and not all medical cases are right for robotic-assisted surgery—some patients may benefit from endoscopic or open (traditional) surgery.

2.4 Non-robotic minimally invasive surgery (endoscopic)

Non-robotic minimally invasive surgery is also known as endoscopic surgery. You also may be familiar with terms like laparoscopic surgery, thoracoscopic surgery, or "keyhole" surgery. These are minimally invasive procedures that utilize an endoscope to reach internal organs through very small incisions.

During endoscopic surgery the surgeon inserts a thin, flexible tube with a video camera through a small incision or a natural orifice like the mouth or nostrils. The tube has a channel to utilize tiny surgical instruments, which the surgeon uses while viewing the organs on a computer monitor.

This technique allows the surgeon to see inside the patient's body and operate through a much smaller incision than would otherwise be required of traditional open surgery.

2.5 The benefits of endoscopic surgical procedures can include:

Small incisions, few incisions, or no incision
Less pain
Low risk of infection
Short hospital stay
Quick recovery time Less scarring

Reduced blood loss

2.6 Some conditions treated at Johns Hopkins using non-robotic minimally invasive surgery include:-

General – Pancreatic cancer, benign pancreatic lesions, hernias, severe gastroesophageal reflux disease (GERD), liver tumors (benign and malignant), gallbladder cancer, obesity (gastric bypass, bariatric surgery, gastric banding), gastrointestinal/rectal conditions, hernias (paraesophageal, ventral, hiatal or incisional)
Lung – Some lung tumors, esophageal cancer and diseases Gynecologic – Gynecologic cancer, benign tumors, endometriosis, uterine fibroids, ovarian cysts, benign cervical disorders, conditions requiring hysterectomy, removal of ovaries and staging of lymph nodes
Head and neck – Skull base brain tumors, anterior cranial fossa (front skull base) tumors, posterior cranial fossa (back of the skull base) tumors
Heart – Atrial septal defects, aortic regurgitation, aortic insufficiency, aortic stenosis, mitral valve repair
Neurosurgery/Spine – Spine conditions, cervical disc hernias, lumbar disc hernias, degenerative disc disease, spinal trauma: skull base brain tumors, anterior cranial fossa (front skull base) tumors, posterior cranial fossa (back of the skull base) tumors
Vascular – varicose veins, venous insufficiency, per bagvi vascular disease
Urological – Kidney disorders, kidney cysts, kidney stones, kidney blockage, kidney donation, prostate cancer, incontinence, vaginal prolapse

2.7 What are the advantages of robotic surgery?

One of the main advantages is that it enables surgery through smaller incisions.

Other advantages of robotic surgery include:

Greater precision: The robotic arm's movements are more exact than a human hand. And their range of motion is greater. The arms rotate instruments in tight spaces in ways that aren't otherwise possible.
Better visualization: A sophisticated camera provides magnified, high-definition views of the surgical area. It also has 3D capabilities for imaging that are superior to the naked eye.
Ability to do surgery inside the body: The small instruments allow surgeons to perform steps of the operation inside your body when traditionally, they would have had to make a much larger incision to do that part of the procedure outside of your body.

Robotic-assisted surgery enables you to receive sophisticated treatments with less downtime. A specially trained surgeon uses robotic technology to operate through small incisions. Robotic surgery can be used to treat conditions affecting your heart, digestive system, bladder, prostate and more. Benefits include less blood loss, shorter hospital stays and quicker recovery. Surgeons who have performed a high volume of these procedures typically deliver optimal outcomes.

2.8 Disadvantages of robotics platform for minimal

Surgery is an expensive proposition at the best of times. The high cost of installing a robotic surgery system can increase the cost of a surgical procedure. Surgical robots are costly to maintain, and their operation requires additional training, which is also expensive.
One of the most significant problems with robotic surgery is the issue of latency — the time it takes for the robot to carry out the surgeon's commands. It takes a few moments for the computer to communicate with the look robotic arms. While this isn't an issue for routine surgeries, it makes it difficult for surgeons to respond quickly to problems that occur during the operation.

3 Conclusion

Robotic Surgery in the Coming Years
With the right expertise and technology, the advantages can eventually overcome the disadvantages. Communication latency is currently the biggest hurdle to overcome to allow this technology to hold a more prominent place in the medical community. Even if the cost of the procedure slows down the integration in hospitals, surgeries with robotic machines will continue to become more commonplace, allowing more precise microsurgeries with improved accuracy.

4 References

hopekinmedicine
pumped.ncbi.
researchgate.com