TITAN MEDICAL

WHITE PAPER

MINIMIZING INCISIONS TO MAXIMIZE PATIENT OUTCOMES - ADVANCING ROBOTIC SURGERY THROUGH A SINGLE INCISION

Abstract

- This paper supports the case for single access robotic-assisted surgery (RAS) and its wider adoption in the surgical setting as part of an evolving ecosystem further advancing surgical care.
- While RAS market uptake has increased since the introduction of sophisticated multi-port robotic systems in 2000, there is an oppportunity for additional clinical advancements using smaller-scale minimally-invasive, user-friendly systems through a single incision in the abdomen.
- Single access RAS provides the opportunity to improve the quality of care to patients and to reduce costs to the healthcare system by enabling patients to quickly recover after procedures.
- Increased competition and adoption of single access RAS systems and technologies is expected to result in systems that are easy to set-up and learn, augment the skills of the surgeon, enhance efficiencies of the surgical team and may result in improved patient outcomes.

The Case for Single Access

Since the advent of manual laparoscopy in the 1980's and robotic-assisted laparoscopy in the 2000's, surgical techniques utilizing multiple incisions (multi-port) have been developed to minimize invasiveness, reduce blood loss, reduce pain and reduce recovery times for conditions previously treated with open surgical techniques. Continued advances in robotic technology have enabled the development of single-access surgical techniques, further minimizing the number of incisions and potentially reducing the resulting compromise of healthy tissues.

Both manual and robotic-assisted laparoscopic surgical methods are typically multi-port procedures that use multiple incisions, with only 3% of global procedures performed robotically.[1] Multi-port procedures are taxing for patients and cause increased trauma and scarring, lengthy hospital stays and a higher risk of complications such as infection.[2] The formation of adhesions is the most common post-surgical complication of abdominal or pelvic surgery.[3] Fewer and smaller adhesions could mitigate the risk of post-surgical trauma. Approximately 64% of patients are prescribed narcotics after multi-port robotic

[1] https://www.medtechdive.com/news/medtronic-hugo-ce-mark-robotic-surgery-intuitive/607987/
[2] https://www.mayoclinic.org/medical-professionals/urology/news/single-port-robotics-reduce-incisions-may-lead-to-less-pain-and-quicker-recovery-from-prostatectomy/mqc-20528373
[3] ten Broek RPG. BMJ 2013; 347: f5588

surgery versus 32% after single-port robotic surgery. Following multi-port robotic surgery, patients are prescribed an average morphine equivalent of 15 mg, versus 7.5 mg after single-port robotic surgery.[4] Increased patient trauma post-surgery is stressful for patients, increases the cost of care and creates difficulties for both surgeons and healthcare systems. The average hospital stay is 26.1 hours after multi-port robotic surgeries, versus 4.3 hours after single-port robotic surgeries.[2]

The Solution: The Enos™ RAS System

Titan's Enos system was developed based on clinical needs identified by surgeons. Specifically, surgeons observed lengthy recoveries following hysterectomies. Titan engaged engineers in the U.S., Europe and Canada to realize the vision for reducing trauma during abdominal surgery. The Enos system has been designed to optimize surgeon performance, allow surgeons to perform tasks enhanced by technology, and enable surgeons to readily access all four abdominal quadrants from one incision site. Importantly, it has been designed to provide an innovative yet simple robotic experience with a smaller footprint as compared to other RAS systems.

Surgeons sit comfortably at a workstation that is designed to provide the surgeon with a surgical image on a large 3D HD screen while providing an open field of view to the wider surgical suite, facilitating direct communication with surgical staff.[5] The motion control systems replicate hand movements and manipulate end-effectors, or tools, coupled to instruments on a patient cart. Ergonomic handle interfaces allow for a comfortable posture while seated upright, designed to minimize surgeon fatigue while providing control of an endoscope and instruments that support access to a large surgical workspace. Instinctive movement and triangulation of the end-effectors is achieved with snake-like, multi-articulating instruments and a primary steerable 3D HD endoscope delivered through a single point of entry.

The patient cart consists of a positioning arm, instrument and endoscope drive units, and an approximately 25-millimeter single-access cannula that includes a novel integrated 2D camera providing access to and preoperative visualization of the surgical site. Each of the multi-articulating instruments and 3D HD endoscope (along with its integrated light source) are introduced through the cannula. The instruments are designed to operate effectively both close to the incision wall and at a distance to provide access to a large surgical volume. The dexterity and strength of the instruments provide the ability to manipulate tissue, encircle the target anatomy and mitigate collisions of instruments inside the patient. Additionally, the versatile Enos system enables surgical access to all four abdominal quadrants from one small incision. Input devices and motion control systems were designed to convert natural hand gestures to precise end-effector movements.

---

[4] Lenfant L, Sawczyn G, Aminsharifi A, et al. Pure single-site robot-assisted radical prostatectomy using single-port versus multiport robotic radical prostatectomy: a single-institution comparative study [published online ahead of print, 2020 Nov 4]. Eur Urol Focus. 2020;S2405-4569(20)30290-X.

[5] https://titanmedicalinc.com/technology/

The Enos system's reduced footprint facilitates hospital movement from room to room. The system has been designed with fewer moving components as compared to other RAS systems, providing quicker draping and docking workflows for more efficient use of surgical time.

The Enos system's design and innovations are protected by an intellectual property portfolio of over 220 global patents and applications. Titan's intellectual property portfolio with its early priority dates, continued filings, pending patent families and broad coverage, uniquely position it among new RAS entrants, providing it with potential strategic opportunities, including the licensing arrangement and collaboration with Medtronic plc.[6] Under the licensing arrangement with Medtronic, a portion of Titan's intellectual property portfolio has been licensed while Titan retains world-wide rights to independently commercialize its technologies for use with the Enos system.

Conclusion

Titan's Enos single access RAS system was designed with consideration for the needs of patients and surgeons based on shortcomings of laparoscopic surgery and areas for improvements in robotic technologies. The Enos system's innovative technology employs dexterous instrumentation for precise movement and advanced imaging systems for enhanced visualization. The system is comprised of fewer moving components and the design of the open and ergonomic surgeon workstation facilitates direct communication with the surgical team. The patient cart consists of a single arm, providing the surgical team the ease of preparing the Enos system for the next surgery while also facilitating easy transfer between surgical suites. With these innovations, the Enos system may simplify surgical workflows, increase hospital efficiency, and reduce costs. Titan's unique intellectual property portfolio with continued innovations incorporates tomorrow's vision for single access robotic-assisted surgery today.

[6] https://ir.titanmedicalinc.com/news-events/press-releases/detail/366/titan-medical-signs-definitive-agreement-with-medtronic