

# Special REPORT

## The Future of Robotic Surgery

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### Discussing Advancements in Robotic-Assisted Surgery: SAGES 2023

At the 2023 meeting of the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) in Montréal, Canada, Namir Katkhouda, MD, a bariatric surgeon in Los Angeles, California, led a live educational session about emerging trends in robotic-assisted surgery. This panel discussion highlighted the ongoing technological revolution and expansion of robotic-assisted surgery. Faculty experts discussed the tools they use to improve outcomes and workflow in their practices and shared their views on a transforming surgical landscape. “Robotic surgery is a progression that cannot be stopped,” Dr Katkhouda said. “Technology is going to improve, and younger surgeons are entering the field having been raised on electronics. The future is bright for robotic surgery.”

### Robotic-Assisted Surgery in Hernia Repair: Addressing an Unmet Need

Minimally invasive techniques have gained prominence for inguinal hernia repair and offer a range of advantages over open surgery.<sup>1,2</sup> Laparoscopic approaches are effective and support a faster recovery with lower infection rates.<sup>2,3</sup> Although these advantages have encouraged widespread adoption of laparoscopic surgery, some challenges remain for mesh replacement and defect closure via straight-stick laparoscopy and are fueling demand for more sophisticated tools.<sup>1,3</sup> Some anatomic locations are difficult to reach and ergonomically challenging for surgeons with traditional laparoscopy.<sup>4</sup> According to Brian Jacob, MD, FACS, a private practice surgeon at NYC Hernia who is also affiliated with the Icahn School of Medicine at Mount Sinai, in New York, New York, laparoscopic mesh placement in the retromuscular or preperitoneal space in the abdominal wall can be difficult, and robotic tools help surgeons maintain comfortable body positions while facilitating precise dissection, defect closure, and mesh placement.<sup>4,5</sup>

“When robotics first started in the hernia space, a lot of surgeons learned how to do robotics because of the enhanced precision, faster patient recovery, and lower infection rate.<sup>2,5</sup> Surgeons were able to learn how to do a minimally invasive inguinal hernia repair in a more standardized way,” Dr Jacob said.<sup>6</sup> “Then it became, ‘Can we duplicate

this ability in the abdominal wall? It turns out, we could start dissecting out the abdominal wall using robotic instruments in a way that we couldn't easily do with laparoscopy. We owe a tremendous amount to Drs Jorge Daes, Igor Belyansky, Conrad Ballecer, and Yuri Novitsky, who pioneered key discoveries along the way."

### Choosing a Robotic-Assisted or Laparoscopic Approach

The benefits of robotic-assisted surgery include a fast learning curve and fewer postoperative complications compared with open repairs, and although operating times may be longer, according to Dr Jacob, patient benefits may be worth the trade.<sup>7,8</sup> Dr Jacob prefers to use robotic-assisted surgery for defects that are 6 cm or wider, where he wants to place mesh outside of the abdominal wall, and to perform extended total extraperitoneal ventral hernia repair with a retromuscular Rives-Stoppa technique or a minimally invasive transversus abdominis release, because the robotic-assisted surgery tools have made the operation reliably reproducible. "I still use laparoscopy for the majority of standard inguinal hernias and for many small ventral hernias," Dr Jacob said. "For the abdominal wall, there's no question that for defects greater than 6 cm in the midline, a robotic retromuscular repair is my first choice. Robotic hernia repair is also my first choice for atypical hernias, such as in the flank, the subxiphoid, and the suprapubic locations. It makes those operations beautiful and easier than laparoscopy."

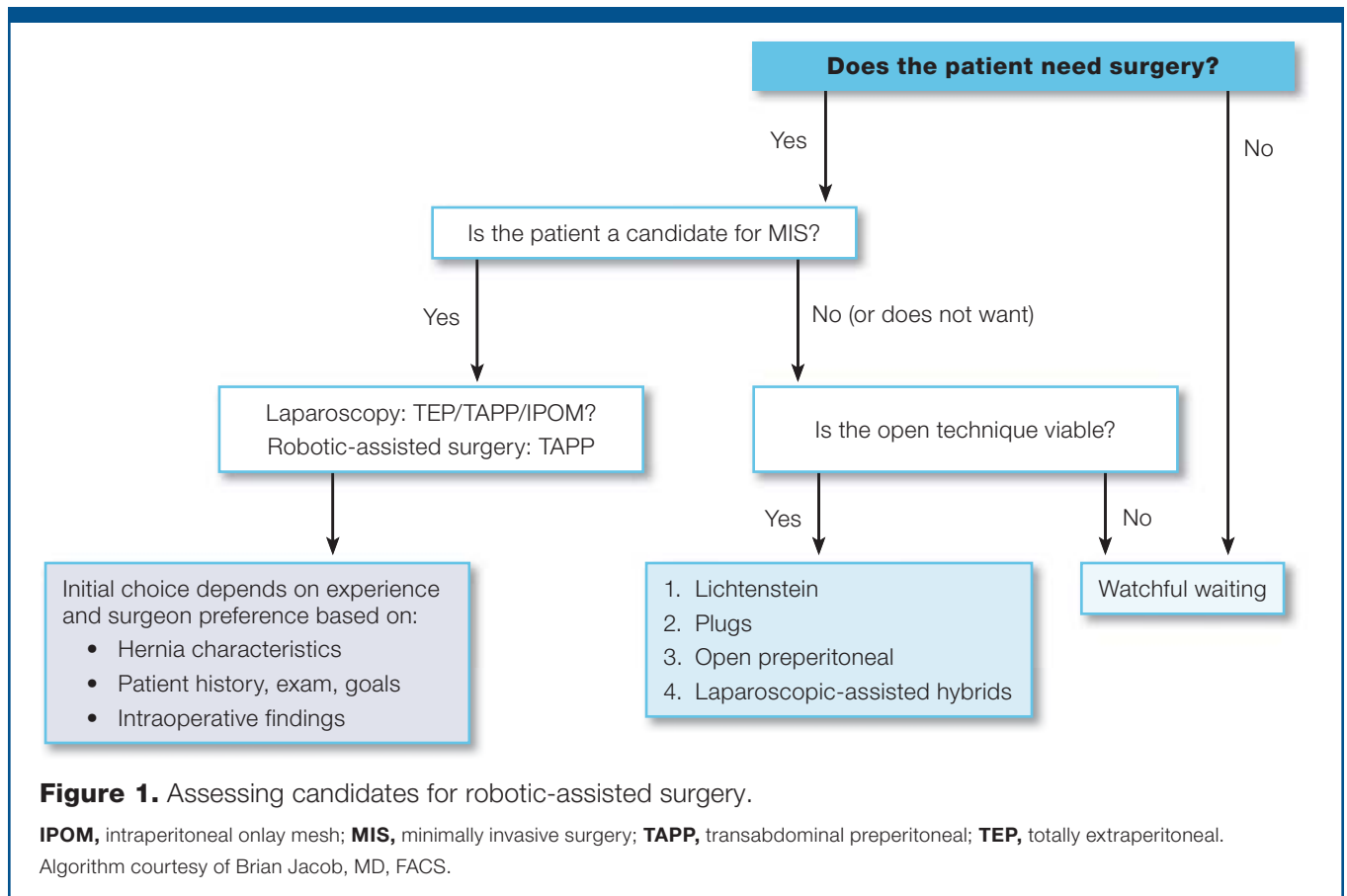
For Dr Jacob, robotic-assisted surgery is not an "all-or-nothing" proposition. He believes laparoscopy is great for

many surgeries, although he has adopted robotic-assisted surgery for many hernia repairs and bariatric procedures. In fact, he developed an algorithm for helping surgeons choose the best approach based on various patient factors (Figure 1) and acknowledges the importance of individual surgeons having the freedom to work with the tools that give them the best outcomes. "With laparoscopy and hernia, there are a few great operations that have stood the test of time. If you're comfortable with an operation and you get good outcomes, you don't necessarily need to evolve to the next technology," Dr Jacob said.

### Training Considerations

Training opportunities include reputable online resources and videos from experienced surgeons,<sup>9,10,a</sup> training from device manufacturers, and hands-on experience through cadaveric courses.<sup>11</sup> When incorporating robotic-assisted surgery into clinical practice, Dr Jacob recommends starting with easier cases to gain experience and confidence before moving on to more challenging procedures.

"A robot doesn't work itself; we're far away from that. You still need a careful, experienced surgeon behind that device to produce a good outcome," Dr Jacob said. "Also, having a trusted surgeon present during use of new equipment can be key to overcoming early hurdles. With every new procedure, there are known complications. It's important to have a plan B if they occur so you're not surprised." Dr Jacob believes robotic-assisted surgery will become a standard method of treating many hernias. "I think it will continue to expand. We're going to have a number of different companies making



surgical robots, which will drive down costs and enhance our ability to use them,” he said.

## Robotic-Assisted Surgery in Bariatrics

Erik B. Wilson, MD, FACS, a professor and the vice chair of surgery and the bariatric surgery medical director at Memorial Hermann Health System, in Houston, Texas, was impressed after seeing how robotic-assisted surgery was better able to preserve blood supply during revisional dissections compared with laparoscopy.<sup>12</sup> “When you’re doing a revisional bariatric surgery, everything’s been cut on once. You’ve got to go back and not remove any more blood supply, if at all possible. You’ve really got to be careful,” Dr Wilson said. “Robotic-assisted surgery allows you to dissect very precisely.<sup>5</sup> We’re taking a complex patient and producing the outcomes of a primary patient because we can use robotics with such high precision.” In fact, as an investigator, Dr Wilson has found that patients undergoing primary and revisional Roux-en-Y gastric bypass with robotic-assisted surgery exhibited comparable outcomes.<sup>13</sup>

The use of robotic-assisted surgery is steadily growing in bariatrics.<sup>14</sup> Dr Wilson believes its adoption allows more surgeons to safely and comfortably perform procedures in patients with complex or hostile abdomens. “Surgeons are going to benefit with this technology. We will learn more. We’re going to have more attention focused on training, and it’s going to push along our clinical outcomes, all at a rapid pace. We need to improve our skills for more complicated cases,” Dr Wilson said. “Robotics is helping to drive that.”

## Smart Stapling Technology

For both laparoscopic and robotic-assisted procedures, Dr Wilson uses the Signia™ stapler, a single-handed stapler with powered articulation, rotation, clamping, and firing.<sup>15,b</sup> The force-sensing technology automatically adjusts the firing speed to optimize staple formation in variable tissue thicknesses and when forces increase in challenging applications.<sup>16,17,c</sup> A display screen in the Signia™ stapler handle provides visual feedback, identifying zones based on clamp force measurement. The firing speed adapts to these measurements, slowing as higher forces are experienced, while the gauge on the handle climbs from zone 1, the lowest, to zones 2 and 3.<sup>18,c</sup> Research has shown that adjusting the speed of firing in thicker tissues can increase staple line security by up to 21%.<sup>16,17,19,c</sup> “Smart stapling technology gives you feedback on when you should slow down during stapling, and it slows down for you. If a surgeon is not paying close attention to the tissue, it helps them become safer,” Dr Wilson said. “It also teaches surgeons about the tissue. If we’re curious at all, we should ask questions: ‘Why is the stapler pausing? Should it be pausing in this situation? Why would or wouldn’t it be?’ That gets us to evaluate tissue more effectively.”

## Digital Surgery and Artificial Intelligence

According to Francesco Bianco, MD, FACS, an associate professor of surgery in the Division of General, Minimally Invasive and Robotic Surgery at the University of Illinois Chicago, artificial intelligence (AI)-based tools are poised to have a substantial impact on the surgical field. By leveraging data from patient health records, diagnostic images, and surgical videos, AI has the potential to assist surgeons from planning to intraoperative decision making to postoperative assessment.<sup>20</sup> “There are a lot of AI technologies in medicine, but

very few in surgery,” he said.<sup>21</sup> “Surgery poses different complexities, but there are ways in which AI can make an immediate difference.<sup>21</sup> I see AI assisting in surgery by analyzing patient information, vital signs, imaging, and progress during the surgery, then providing real-time suggestions for a surgeon to consider during a procedure.<sup>20,22</sup> This will increase the accuracy and efficiency.”

Robotic-assisted and laparoscopic surgeons generate a large amount of video data that can be used to train AI algorithms to assist surgeons as they operate.<sup>20,21</sup> Computer vision performs analytics with video information and is a key component of surgical AI systems.<sup>21</sup> However, a lack of standardized procedures for collecting surgical videos has limited data quality for analysis and created a need for improved surgical AI models.<sup>23</sup>

## Touch Surgery™ Enterprise: Surgery at Your Fingertips

Touch Surgery™ is the first AI-powered surgical video and analytics platform for the operating room and is transforming video data into actionable insights (Figure 2). This technology empowers surgeons to learn, collaborate, and improve their performance through the power of video.<sup>10,a</sup> For example, surgeons can share videos with colleagues and receive objective feedback or with trainees and teams to prepare for a case. “You can easily record surgical videos and describe complications, bleeding, and unusual anatomy, and these become searchable tags,” Dr Bianco said. “It’s great for training and collaboration. You can easily access the videos using a phone or computer, present videos at meetings, and use them to assess performance. I find Touch Surgery™ helpful for safely recording videos, providing easier access to technology, and as a teaching and collaboration tool, even from remote distances.”

The Touch Surgery™ video platform enables surgeons to benchmark their progress.<sup>d</sup> “We can compare data,” Dr Bianco said. “We can compare characteristics like timing, for instance. Let’s say I perform a cholecystectomy; it takes 25 minutes and each of the procedural steps has individual timings. I can now compare this specific surgery with my previous surgeries and see where I can improve. I can compare the surgeries with my peers. There are multiple layers of analysis allowed through this technology.”<sup>d</sup>

In addition, Touch Surgery™ prioritizes data security every step of the way. Traditional approaches for storage, such as USB sticks and hard drives, can be easily lost or stolen, putting important data at risk. The Touch Surgery™ platform is secure by design, with end-to-end encrypted upload to the Touch Surgery™ Enterprise cloud platform through a secure application programming interface. Users can take advantage of unlimited storage on a highly secure HIPAA-compliant cloud. Dr Bianco appreciates the ability of Touch Surgery™ to produce large data sets of high-quality videos that come from different hospitals and centers. “This is the basic requirement for developing robust AI algorithms,” he said.

## Conclusion

The expert panelists at the 2023 SAGES meeting discussed the adaptability of the Medtronic technology portfolio, which is designed to support surgeons across specialties as they expand their capabilities, and shared their excitement for the future of robotic-assisted surgery, which Dr Wilson



**Figure 2.** Touch Surgery™ Enterprise is the first AI-powered surgical video and analytics platform for the operating room, with end-to-end encrypted upload. It features unlimited storage on a highly secure HIPAA-compliant cloud.

AI, artificial intelligence.

believes will facilitate the improvement of surgical procedures. “Robotic surgery is so important because it’s going to give us a lot of data. As we’re given the data intraoperatively, we’re going to make better decisions.<sup>20</sup> It’s going to make us better surgeons, and I think that’s important for us to embrace.” Dr Katkhouda agreed: “We are at the beginning of the revolution,” he said.

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The Medtronic Touch Surgery™ Enterprise is not intended to direct surgery, or aid in diagnosis or treatment of a disease or condition.

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## Footnotes

- Based on a randomized controlled trial in porcine models.
- Thirty-eight out of 38 surgeons surveyed agreed.
- Preclinical results may not correlate with clinical performance in humans.
- Postoperative insights are available for selected procedures in selected countries for selected customers.