Symani® SURGICAL SYSTEM

The Role of Robotics in Open Dissection:

The real-world applicability and value of robotic microsurgical dissection

Overview

Microsurgical dissection presents significant challenges, including high technical demands, risks to tissue integrity and collateral damage, and physically demanding ergonomic conditions for surgeons.

Robotic microsurgery can help surgical teams address these challenges. The newest additions to MMI's instrument portfolio, the NanoWrist® Scissors and Forceps, expand the role of the Symani® Surgical System beyond anastomosis into this critical phase of the procedure. By enabling precise, controlled dissection, these instruments are aiming to address key determinants of flap viability, tissue integrity, and preservation of donor-site function.

According to Francesca Ruccia, M.D., F.R.C.S., consultant plastic surgeon and an early adopter of robotic microsurgery at The Royal Marsden NHS Foundation Trust in London, dissection and anastomosis represent the two most delicate phases of a microsurgical procedure.

Dr. Francesca Ruccia,
Reconstructive Plastic Surgeon,
The Royal Marsden Hospital

Dr. Ruccia is an expert in autologous breast reconstruction, complex gynecologic reconstruction, and perineal reconstruction following skin cancer surgery. In this paper, she shares her clinical experience with the Symani Surgical System, with particular emphasis on the NanoWrist Scissors and Forceps and their role in supporting microsurgical dissection. She also offers practical insights and lessons learned for surgeons who are currently using or considering the adoption of Symani.

Incorporating robotic-assisted microsurgical dissection may enable surgeons and institutions to operate at the forefront of surgical care and to explore new approaches beyond the limits of manual instrumentation.

The Challenges of Open Microsurgical Dissection

Due to the delicate nature of the tissues and the extreme precision required, robotic-assisted open microsurgical dissection has the potential to help surgeons overcome the significant challenges and risks associated with manual open microsurgery including:

- **High technical demands:** Open microsurgical dissection requires surgeons to operate in confined, anatomically complex spaces with limited visualization. Achieving precise dissection under these conditions is technically demanding, and instruments, bleeding, and suboptimal lighting can disrupt workflow and increase procedural complexity.

- **Risk to tissue integrity and collateral damage:** Maintaining tissue, vessel, and nerve integrity requires exceptional control of fine instruments and sutures. Limited access and the need for meticulous manipulation increase the challenge of avoiding unintended trauma to tissue, vessels, or nerves.

- **Physically demanding ergonomics:** Open microsurgical dissection places significant physical strain on surgeons. An estimated 80% of surgeons experience work-related injury due to poor posture; prolonged operation in awkward, fixed positions can result in neck and back pain, fatigue, and the potential for errors.[1, 2]

Robotic-assisted Microsurgery Helps Surgeons Surpass Physical Limitations

Many of these challenges and risks can be addressed through a robotic-assisted microsurgical approach that now includes Symani's NanoWrist Scissors and Forceps, which are described in the next section. Compared to manual open microsurgery, the Symani Surgical System offers:[3, 4, 5]

Motion scaling:
Translates the surgeon's large, natural hand movements at the console into significantly smaller, more precise movements of the robotic instruments.

Tremor reduction:
Uses algorithms to filter unintended hand movements.

Micro and supermicrosurgical instruments:
Feature a small size and increased freedom of movement, enhancing precision and control.

The anticipated clinical and economic benefits may include enabling less invasive reconstructive approaches that could shorten hospital length of stay, improve recovery, reduce complications, and lower overall hospital costs.[6]

In addition, robotic microsurgery improves surgeon ergonomics by enabling the surgeon to operate from a comfortable, seated console, reducing the physical and cognitive strain associated with traditional open surgery. By enhancing the surgeon's natural abilities, the robotic system reduces physical stressors that contribute to fatigue and career-limiting musculoskeletal injuries.[7]

Dr. Ruccia believes that incorporating robotic dissection instruments into open microsurgery provides meaningful long-term ergonomic benefits that could help her and other surgeons extend their careers.

The Advantages of Fully Wristed Robotic Instruments

Symani's NanoWrist Scissors and Forceps are the first and smallest fully wristed robotic instruments designed specifically for dissection in open microsurgery. These dissection instruments provide precision in confined spaces and a range of motion that traditional instruments cannot achieve, enabling additional phases of the procedure to be performed robotically and expanding the scope of applications and procedures that can be performed with a robotic microsurgical system.

Beyond breast reconstruction and other reconstructive plastic surgery procedures, the NanoWrist Scissors and Forceps may also be applied in supermicrosurgical procedures such as lymphovenous bypass (LVB) and perforator-to-perforator (P2P) free flap transfers, as well as other complex procedures, including head and neck cancer surgery, where preservation of critical structures is essential.[8]

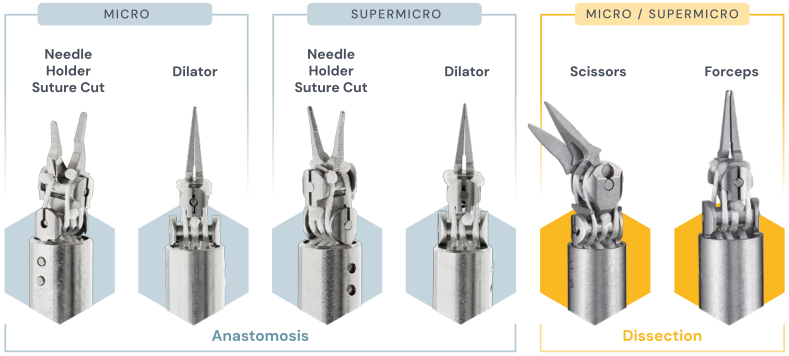


Figure 1. The NanoWirst Instrument Portfolio features the smallest wristed instruments, with full articulation, for multiple aspects of the procedure.

Expected Clinical Benefits of Dissection Instruments

Scissors have the potential to:

- Preserve anatomical structures and tissue integrity through controlled incisions
- Reduce the risk of unintended tissue and nerve damage and bleeding [9]
- Enable less invasive perforator approaches to improve outcomes.

Forceps have the potential to:

- Optimize procedural workflow by minimizing the need for multiple instruments due to its multifunctional design
- Reduce vessel trauma and damage
- Improve control and precision
- Handle complex tasks due to distal articulation
- Enable more precise needle placement and tissue pass through.

MMI's training team offers a structured training and certification program for both surgeons and operating room staff.

Surgeon Experience: Case Examples from Dr. Ruccia

An early adopter of robotic-assisted microsurgery in plastic and reconstructive surgery, Dr. Ruccia primarily performs DIEP flap breast reconstruction, averaging approximately 120 cases per year.

In July 2025, leveraging the full capabilities of the Symani Surgical System, including the new NanoWrist dissection instruments and the Synaptix™ Digital Surgery Platform, Dr. Ruccia performed the first robotic-assisted pedicle dissection in DIEP flap breast reconstruction on a 46-year-old female patient. The procedure involved removal of a right breast implant and the associated fibrous capsule, followed by harvest of a tissue flap from the left abdomen for reconstruction of the right breast.

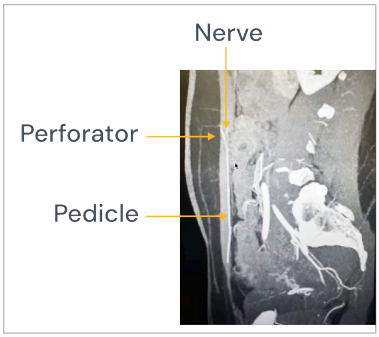


Figure 2. Location of anatomy

The robotic-assisted dissection phase included meticulous skeletonization of the deep inferior epigastric vessels and the accompanying nerve. Both dissection and anastomosis were completed robotically without complications or the need to revert to manual techniques.

Dr. Ruccia operated from the console in the same room as the patient to maintain direct visualization of the surgical field, while another surgeon assisted at the bedside to manage hemostasis.

"The NanoWrist Scissors performed well in tissue dissection, providing stable, tremor-free cuts and controlled movement," Dr. Ruccia said.

> Compared to manual tools for DIEP breast reconstruction without robotic assistance, there is a stark contrast with the robotic-assisted dissection instruments. It felt like going from a Motorola to an iPhone 17 Pro.

According to Dr. Ruccia, initial challenges associated with the new instruments were quickly overcome with experience and improved procedural planning. By her second robotic microsurgical DIEP procedure, only minor adjustments were required, resulting in a considerably faster operation.

During the procedure, Dr. Ruccia used the NanoWrist Scissors for both blunt and sharp dissection using the lateral portion of the instrument to dissect branches along the main pedicle, and the central portion to perform sharp dissection in very tight spaces to cut fascia.

The sharpness of the NanoWrist Scissors enabled Dr. Ruccia to cut through dense fascia typical of a younger patient, while the wide angle of rotation beyond the natural range of the human hand and wrist allowed for very precise dissection.

Similarly, she found that the Forceps provided excellent grip, allowing secure handling of the vessel adventitia and precise traction throughout dissection.

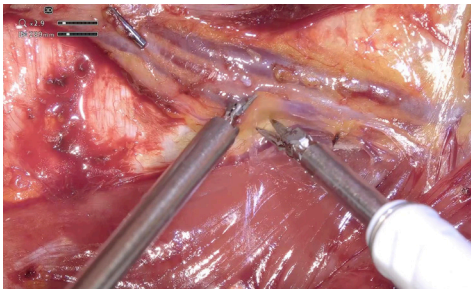


Figure 3. Pedicle dissection

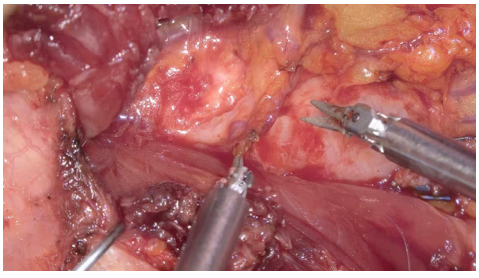


Figure 4. Vascular branch dissection

Overall, Dr. Ruccia reported that the new robotic instruments enabled tremor-free manipulation and extended robotic capabilities into earlier stages of flap dissection. She noted that intuitive use, workflow efficiency, and a short learning curve will likely support rapid adoption and seamless integration into practice.

"This marks a significant evolution in reconstructive plastic surgery, especially as instruments, workflow, and visualization tools continue to be refined," she said. "Ultimately, these new tools could lead to better recovery and enable personalized treatment options."

Streamlining the Use of Robotic Dissection: Dr. Ruccia's Experience

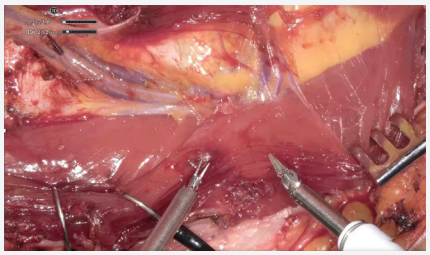


Figure 5. Positioning for robotic dissection

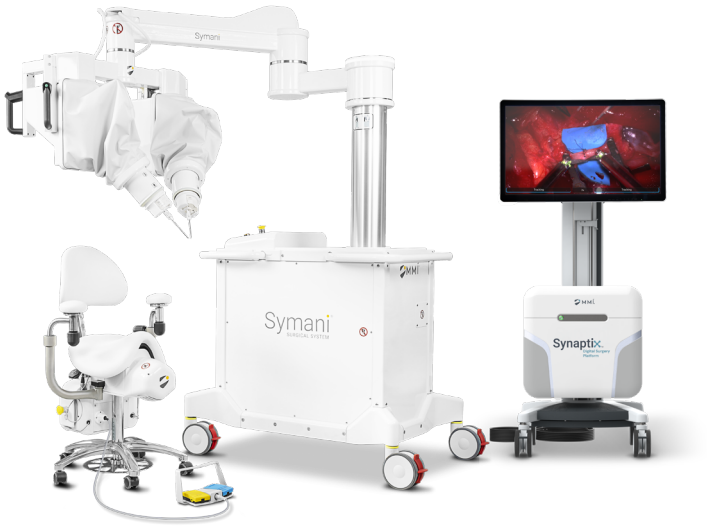
- **Optimize robotic instrument positioning** through practices that include keeping vessels within the upper third of the visual field, maintaining proper instrument alignment, and avoiding over-rotation of the NanoWrist Scissors.

Figure 6. OR set-up with the Symani Surgical System and Synaptix

- **Plan setup in advance** by positioning Symani in its optimal location from the start, which can help minimize the need for frequent intraoperative repositioning of the robot. [10, 11]

Emerging Applications

The Symani Surgical System is designed to help surgeons restore function and quality of life for patients. By introducing new instruments alongside digital capabilities, MMI aims to create an interconnected ecosystem that empowers surgeons with enhanced precision and control throughout the procedure.[12] Dr. Ruccia found that the Synaptix Digital Surgery Platform enhanced autonomy and workflow efficiency by integrating digital visualization with the Symani Surgical System.



The addition of energy to robotic microinstruments that could enable surgeons to cut, coagulate, and seal blood vessels robotically is also something that further excites Dr. Ruccia.

"Energy power will change everything," Dr. Ruccia. "With energy, I won't even need an assistant."

Dr. Ruccia is excited to see the application of robotic microsurgical dissection across additional specialties, including pediatric microsurgery*, trauma replantation*, and urological* procedures, and sees potential value in its use for fine dissection and vessel preparation for complex procedures such as P2P flaps.[13]

As the NanoWrist instrument portfolio continues to expand, the multifunctionality of the Symani Surgical System is expected to evolve further, increasing the value of robotic-assisted open microsurgery and supporting improved surgical workflows and patient outcomes.

Bringing Symani Into Microsurgery Programs

Adopting new technologies such as the Symani Surgical System can help surgeons and hospitals remain at the forefront of surgical innovation.

"One of our core values must be innovation – pushing the boundaries, getting out of your comfort zone, being in the news – because this is how you also get funding," Dr. Ruccia said.

For hospitals, the addition of robotic microsurgery may help differentiate surgical programs, creating opportunities for program growth, visibility, and leadership.

For surgeons already familiar with robotic platforms in other specialties, robotic-assisted microsurgery and supermicrosurgery may represent a natural progression in their practice. Even initially hesitant surgeons may recognize its emerging role in the future of surgical care.

"Do you want to be an early user? Do you want to be in front of it or do you want just to be at the end?" Dr. Ruccia said. "Eventually, those slow to adopt will have to learn the new skills because everyone else has them and they're the standard of care. Like it or not, technology will come."

Surgeons today have the opportunity not only to become early adopters, but also to help shape how robotic open microsurgery enables new surgical approaches and advances patient care. By envisioning how the Symani Surgical System and the expanding NanoWrist instrument portfolio can be applied, surgeons may extend beyond the limitations of manual instruments.

Ultimately, these advancements have the potential to translate into meaningful benefits for patients. As Dr. Ruccia noted, "in the future, we will be able to show that the return to life will be faster because you will heal quicker."

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*Symani is not cleared for these uses in the U.S. by the FDA. Refer to global indications for more information.

The safety and effectiveness of NanoWrist energy instruments has not been evaluated by the FDA or other governmental regulatory bodies. They are under development and not approved or cleared for commercial use. Future availability cannot be guaranteed.

CE 0051

The Symani Surgical System is authorized for use in the U.S. by the FDA and is a CE marked medical device. Consult your local representative to confirm availability in other geographies. For product indications specific to your region, visit www.mmimicro.com/indications.

Caution: Federal law restricts this device to sale by or on the order of a physician.

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